

A new genus and thirteen new species of sea stars (Asteroidea: Echinasteridae) from the Aleutian Island Archipelago

ROGER N. CLARK^{1,2} & STEPHEN C. JEWETT³

¹Associate in Invertebrate Zoology, Los Angeles County Museum of Natural History, 900 Exposition Blvd., Los Angeles, California 90007

²Research Associate, Invertebrate Zoology, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road, Santa Barbara, California 93105 USA. E-mail: insignis_one@yahoo.com

³Research Professor, Institute of Marine Science, 128 O'Neill, P. O. Box 757220 University of Alaska Fairbanks. Fairbanks, Alaska, 99775-7220.

E-mail: jewett@ims.uaf.edu

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Abstract

A new genus and thirteen new species of echinasterid sea stars are described from nearshore waters of the Aleutian Islands. The new genus *Aleutihenricia* is distinguished from *Henricia* by the morphology and arrangement of the skeletal ossicles. *Henricia beringiana* D'yakonov, 1950 is designated as the type species. The new species described include *Aleutihenricia federi*, *Henricia lineata*, *H. uluudax*, *H. iodinea*, *H. rhytisma*, *H. gemma*, *H. echinata*, *H. vermillion*, *H. elachys*, *H. insignis*, *Odontohenricia aurantia*, *O. ahearnae*, and *O. violacea*. In addition to the descriptions, associations between echinasterids and sponges are briefly discussed. A key to the shallow water (<20 m) Echinasteridae of the Aleutian Islands is provided.

Key words: *Henricia*, *Aleutihenricia*, *Odontohenricia*, AKMAP, Alaska

Introduction

From the Alaska Peninsula, the Aleutian Islands extend westward from Unimak Island to Attu Island over a distance of more than 2,000 km. Over 200 Aleutian Islands form an arc that separates the North Pacific Ocean from the Bering Sea. The southern edge of the Aleutian Islands is bounded by the strong Alaska Current flowing in a westerly direction, with the easterly flowing Aleutian North Slope Current to the north of the Islands. Significant flow from the Alaska Current occurs through 14 passes, providing relatively warm subsurface waters to the Bering Sea (Stabeno *et al.* 1999). The greater Aleutian chain (Fig. 1) extends from the Shumagin Islands, south of the western tip of the Alaska Peninsula (270 km SE of Unimak Island) to the Commander Islands, Siberia, Russia (250 km west of Attu Island) (Campbell & Rennick 1980).

A unique aspect of the Aleutian Archipelago is the ubiquitous encrusting flora and fauna (Chenelot *et al.* in review) that supports a diverse assemblage of benthic invertebrates, including numerous sea stars. Most of the echinasterid sea stars are directly associated with the huge encrusting sponge fauna.

Walter K. Fisher (1911, 1928 and 1930) monographed the sea stars of the North Pacific Ocean, including the Aleutian Islands, based primarily on specimens dredged between 1888 and 1897, by the United States Fisheries Steamer *Albatross*. Little taxonomic research on sea stars in the Aleutians has been published since Fisher's monograph. Fisher recognized five species of the genus *Henricia* Gray, 1840, *Henricia sanguinolenta* (O.F. Müller, 1776), *H. leviuscula* (Stimpson, 1857), *H. aspera* Fisher, 1906, *H. asthenactis* Fisher, 1910 and *H. longispina* Fisher, 1910, along with numerous subspecies and varieties. Verrill (1914) recognized these same species, with the exception of *H. asthenactis*, and added *H. tumida* Verrill, 1909, and introduced some new varieties as well. D'yakonov (1950) recognized five of the six previous species (the exception being *H. sanguinolenta*) along with *H. spiculifera* (H.L. Clark, 1901), *H. dyscrita* Fisher, 1911 (described as a subspecies of *H. leviuscula*), *Henricia arctica* Verrill, 1914, and described *H. orientalis* D'yakonov, 1950, *H. beringiana* D'yakonov, 1950 and *H. derjugini* D'yakonov, 1950 (from the Bering Sea). To the 10 to 12 species previously recognized from this region we add a new genus and 13 new species, and raise another, *Henricia multispina* Fisher, 1910 (described as a subspecies of *H. leviuscula*) to full species level, removing it from the synonymy of *Henricia spiculifera* (H.L. Clark, 1901) proposed by Fisher, (1930) and followed by Lambert (2000). These new species bring the total number of echinasterid species in the Aleutians to more than twenty.

A recent genetic study by Eernisse & Strathmann (2008) has shown that *Henricia leviuscula*, reported by Fisher and others from the Aleutian Islands and by D'yakonov from NE Asian waters, to have a much narrower geographic range, with center of distribution at Puget Sound, Washington, and extending into southeastern Alaska. Eernisse and Strathmann also demonstrate that *H. leviuscula* is part of a large complex of at least ten morphologically very similar species (mostly undescribed) extending from British Columbia south into northern Baja California.

This large radiation of species is present in the Aleutians as well, and is not limited to Echinasteridae (20+ spp.), but also occurs in Asteriidae (15+ spp.), particularly the genus *Leptasterias* Verrill, 1866 (Fisher, 1911; Verrill, 1914) (10+ spp.), Solasteridae Perrier, 1834 (Gale *et al.* 2008) (18+ spp.) and Pterasteridae Müller & Troschel, 1842 (R.N. Clark, *in prep.*) (12+ spp.). Additionally, several families and genera of mollusks in the

Aleutians also contain very large species complexes, many species of which are restricted to portions of the Aleutians [particularly in the Andreanof and Rat Island groups, which seem to have a large proportion of endemic species of many invertebrate groups (R.N. Clark *pers. observ.*). The gastropod family Buccinidae contains more than 60 species in the Aleutians, including over 25 species in the genus *Buccinum* (*s. l.*) Linnaeus, 1758 alone (Dr. James H. McLean, *per. com.* Nov. 2008).

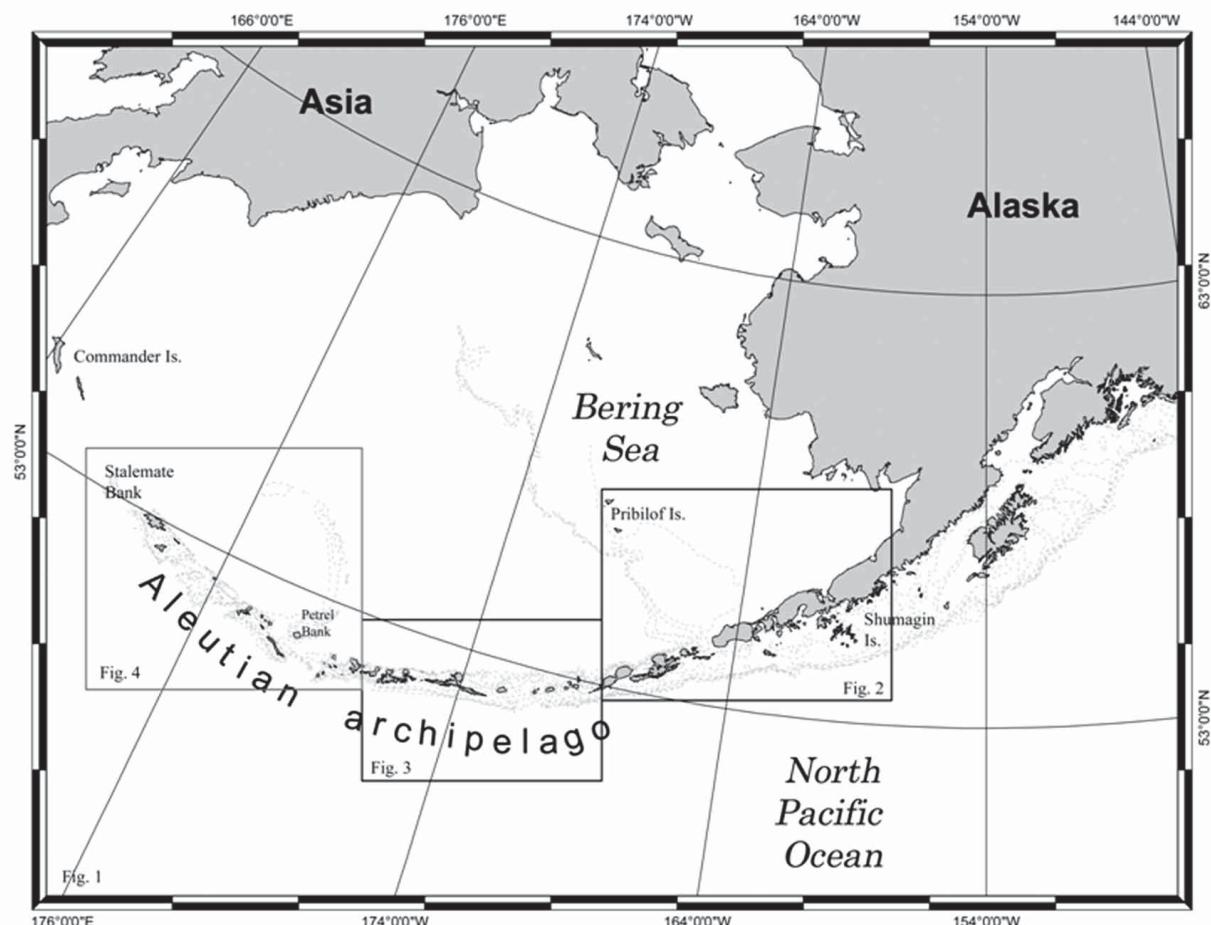


FIGURE 1. Bering Sea and Aleutian Islands.

Perhaps this great diversification of species should be expected in such an extensive region (2500 km east to west), influenced by four major faunal provinces, the Oregonian (temperate eastern Pacific) Province, the Kurile (western Pacific high boreal) Province, the Arctic Province, and the Aleutian (amphi-Pacific) Province (Briggs 1974). The four fauna are distributed as follows. The Oregonian fauna, characteristic of the southern Gulf of Alaska, extends west in the Aleutians to Samalga Pass between Umnak Island and the Islands of Four Mountains. Here there is a major faunistic break, and many notable eastern Pacific invertebrates reach their end point on the west side of Umnak Island, this includes several common mollusks (Vermeij *et al.* 1990; R.N. Clark, *pers. observ.*) and at least two asteroids, *Orthasterias keohleri* (de Loriol, 1897) and *Solaster dawsoni* Verrill, 1880, which are common at Umnak Island, but absent west of Samalga Pass. This pass was previously noted as the western end point for the dominant eastern Pacific kelp *Nereocystis luetkeana* (Mertens), by Miller & Estes (1989). The recently described kelp *Aureophyucus aleuticus* Kawai, *et al.*, is found on the western side of this pass, and may be endemic to Kagamil Island (Kawai *et al.* 2008). This pass presents a physical and biogeographical boundary between the eastern and central Aleutian marine ecosystems (Ladd, *et. al.*, 2004), and may be due (in part) to water temperature, which tends to be 1–2°C cooler on the west side of the pass than on the east side (2006-07 AKMAP survey). One other eastern Pacific species extends further west, *Pycnopodia helianthoides* (Brandt, 1835) has been observed at Little Tanaga Island (AKALE07-

A0005). A second major faunistic break occurs at the large Buldir Pass, between Kiska Island and the Near Islands group. This pass seems to define the eastern extent of the Kurile Province, and many notable northwestern Pacific species, characteristic of eastern Kamchatka and the northern Kurile Islands fauna occur in this region, including the eastern end points of at least four asteroids, *Evasterias retifera* D'yakonov, 1938 (Vicknair 1997), *Asterias microdiscus* D'yakonov, 1950 (K. Vicknair, *pers. comm.*, July, 2008), *Leptasterias squamulata* D'yakonov, 1938 (D'yakonov 1950) (K. Vicknair, *pers. comm.*, July, 2008), and *L. ochotensis* (Brandt, 1851) (D'yakonov 1950) (K. Vicknair, *pers. comm.*, July, 2008). The Arctic fauna is present primarily at the eastern and western extremities of the Aleutians (Fox and Krenitzin Islands in the east, and the Near Islands in the west), has a major influence on the region, and includes many asteroid species *Leptychaster arcticus* (Sars, 1851), *Pseudarchaster parelii* (Duben & Koren, 1846), *Diploptaster multipes* (Sars, 1877), *Pteraster obscurus* (Perrier, 1891), *P. pulvillus* Sars, 1861, *P. militaris* (O. Müller, 1776), *Henricia sanguinolenta* (O. Müller, 1776), *Evasterias echinosoma* Fisher, 1926, *Solaster endeca* (Linnaeus, 1771), *Crossaster papposus* (Linnaeus, 1776) and *Stephanasterias albula* (Stimpson, 1853). The Aleutian Province (as defined herein) extends from the vicinity of the Shumagin Islands, throughout the Aleutian Islands to the Russian Commander Islands, Kamchatka, and the northern Kurile Islands. This Province contains many far ranging species, some of which extend from the northeastern shores of North America (as far south as northern California), throughout the Aleutian chain, to the shores of northwest Asia (northern Hokkaido, Japan), and includes *Ceramaster arcticus* (Verrill, 1909), *C. cf. patagonicus* (Sladen, 1889), *Hippasteria* sp. nov., *Solaster stimpsoni* Verrill, 1880, *Pteraster tesselatus* Ives, 1888, *Pteraster temnochiton* Fisher, 1911, *Henricia aspera*, Fisher, 1906, *H. longispina* Fisher, 1910, *H. asthenactis* Fisher, 1910, *Lethasterias nanimensis* (Verrill, 1914), *Evasterias troschelii* (Stimpson, 1852) and *Leptasterias alaskensis* Fisher, 1930, *Leptasterias leptodoma* Fisher, 1930, *L. hylodes* Fisher, 1930, *L. asteira* Fisher, 1930, *L. aleutica* Fisher, 1930, *L. dispar* Fisher, 1930, *L. trunculenta* Fisher, 1930, *L. stolocantha* Fisher, 1930 and *Aleutiaster schefferi* A.H. Clark, 1939. In addition to these large prominent faunae, the central Aleutian Islands, the Andreanof and Rat Island groups, defined by Samalga and Buldir passes, contain a very rich and diverse fauna that includes several apparently endemic species of asteroides (most of which are undescribed), including: *Pteraster* spp., *Solaster* spp., and several species of the genera *Henricia* and *Odontohenricia*, many of which are described in this document. Numerous endemic species of mollusks and other invertebrates also occur here (Dr. James H. McLean, *pers. comm.*, 2007; R.N. Clark 2000), and this may represent a distinct faunistic pocket, or subprovince. However, more extensive sampling is needed before firm conclusions can be drawn as to the nature of this regions unique fauna. The aforementioned species lists are representative, but by no means complete. Valentine (1966) estimated the percentage of endemic mollusks in the Aleutian province at 24%, from surveys in the region, it appears the endemic asteroid fauna may be as high or even higher.

It might be questioned whether this great complex of species within a single family or genus might be due, at least in part to taxon splitting through application of too strict of typological approach, however, this is not the case as most of the species were found together in the same habitats over a substantial geographic range of hundreds or even thousands of kilometers. A few of the species appear to be short-range endemics, possibly restricted to the central Aleutians. Others may be relatively rare, or restricted to particular ecological niches. All are very distinctive in their characters.

The present study reports on thirteen new species of Echinasteridae collected during the 2006–2007 Alaska Monitoring and Assessment Program (AKMAP), in a few instances where only scarce material was collected, the data is supplemented by material collected subsequently by R.N. Clark in 2008, and previously (1994–2004) by R.N. Clark during NOAA/NMFS benthic trawl surveys in The Aleutian Islands.

Methods

In 2006 and 2007 The Alaska Department of Environmental Conservation (ADEC) and the University of Alaska Fairbanks (UAF) conducted the Alaska Monitoring and Assessment Program (AKMAP) Aleutian Islands survey. Sampling the nearshore (< 20 m), Aleutian Islands.

Sea stars were collected during AKMAP in 2006–2007, and subsequent dives in the region by R.N. Clark in June of 2008. They were gathered using scuba and photographed *in situ* using a variety of digital cameras with underwater housings. Although numerous specimens of many of the new species were observed and photographed in the field, because of restraints on preservative chemicals only a very few samples from widely separated localities were collected.

More than 200 lots of additional material taken in trawl samples from 1994 to 2004 during NOAA/NMFS Aleutian Islands trawl surveys by R.N. Clark were also examined. Exploratory dives were made at Adak and Atka Islands during the 1997 NMFS survey by R.N. Clark and Robert Lauth (NMFS). The respective (known) geographic ranges of the new species are plotted in figures 2–4.



FIGURES 2–4. Aleutian Islands, with distributions of new species plotted. **FIGURE 2.** Eastern Aleutian Islands, Shumagin Islands to Umnak Island. (●) *Aleutihenricia federi*; (◊) *Henricia lineata*; (○) *H. uluudax*; (▲) *H. iodinea*; (◎) *H. rhytisma*; (■) *H. echinata*; (♦) *H. gemma*; (♥) *H. vermillion*; (+) *H. elachys*; (◑) *H. insignis*; (□) *Odontohenricia aurantia*; (æ) *O. ahearnae*; (*) *O. violacea*.

NOAA/NMFS trawl survey data is expressed as a series of numbers (*i.e.* 147-200401-194) for this, 147 refers to the chartered fishing vessel M/V (*R/V Gladiator*), 200401 indicated the year and survey number (some vessels perform multiple surveys in a single year), and 194 refers to the specific trawl number. Additional Survey data is available upon request from Mr. Russel Nelson, NOAA/NMFS, Alaska Fisheries Science Center, RACE Division - F / AKC1, 7600 Sand Point Way NE, Bldg. 4, Bin C15700, Seattle, Washington 98115-0070.

The characters most heavily relied upon for differentiation of species were the spination of the abactinal (primarily on the disc and upper, proximal portions of the rays), adambulacral and oral plates. Once the

particular numbers, morphologies and range of variation of these spines (or spinelets) was determined, they were found to be very consistent and completely reliable in determining species. Even in similar species where there was some overlap in the numbers of spines, this combination of characters was diagnostic. The numbers used in the descriptions and the key are based on a compilation of these characters from all of the available material. The spine counts on the adambulacrals are from the central 2/3 of the ray, very proximal plates often have a more spines, while distal plates usually have a slightly reduced number. It should be noted also, that very small specimens $< R = 1.0$ cm, were generally not available, and would naturally be expected to have lower numbers of spines. Numerous specimens ($N = 20+$) of all previously known species of *Henricia* (with a range of sizes from about $R = 1$ cm, to full adults) from the region, as well as *Odontohenricia fisheri* ($N = 13$) from throughout their respective geographic ranges were examined, and three specimens of *Aleutihenricia beringiana*, and six specimens of *A. derjugini* were also examined, and these characters were found to be very consistent and reliable as well.

Abbreviations used in the text: USNM (National Museum, Smithsonian Institution); LACM (Natural history Museum of Los Angeles County); CASIZ (California Academy of Sciences, Invertebrate Zoology); UAM (University of Alaska Fairbanks, Aquatic Museum).

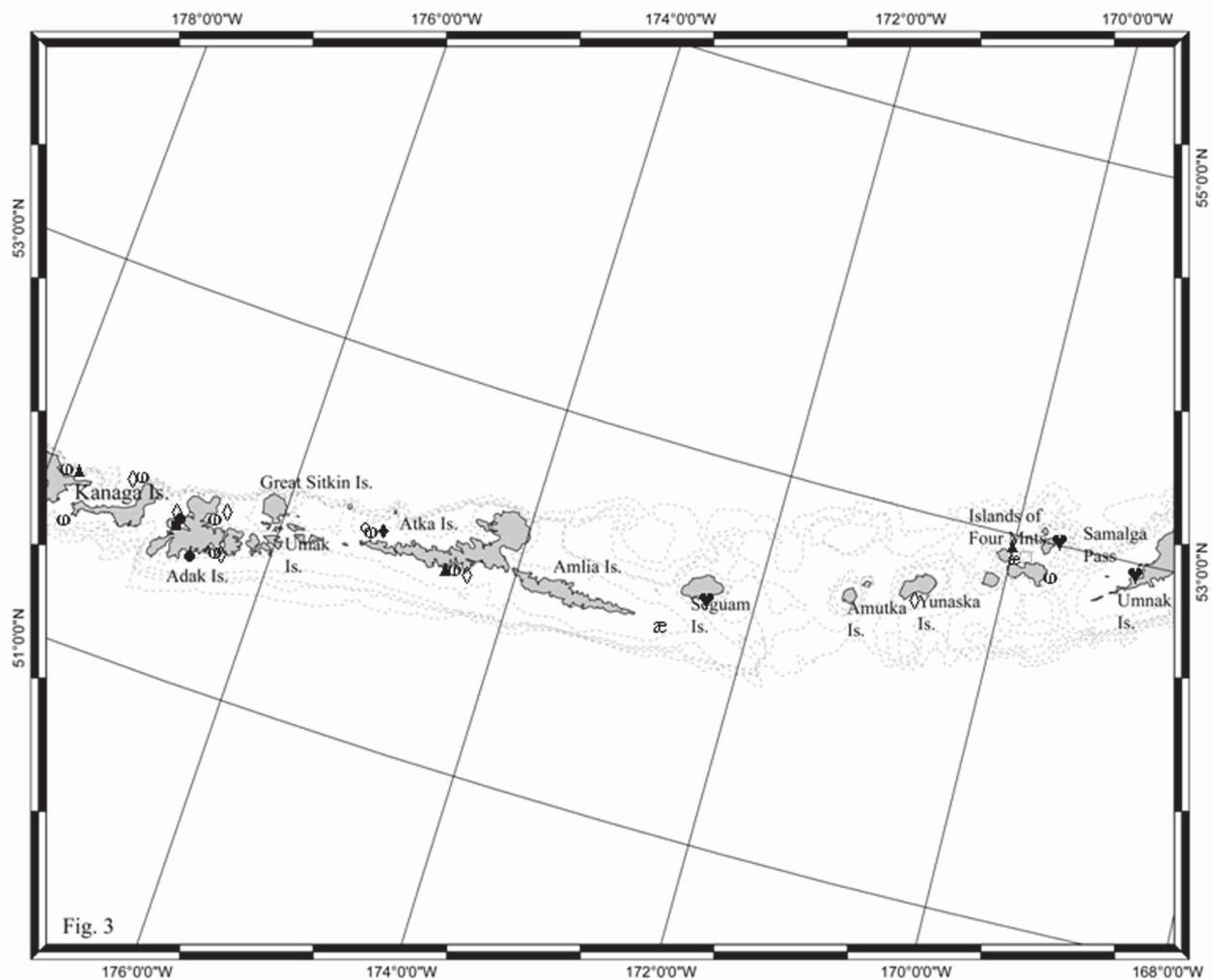


FIGURE 3. Central Aleutian Islands, Samalga Pass to Kanaga Island. (●) *Aleutihenricia federi*; (◊) *Henricia lineata*; (○) *H. uluudax*; (▲) *H. iodinea*; (◎) *H. rhytisma*; (■) *H. echinata*; (◆) *H. gemma*; (♥) *H. vermillion*; (+) *H. elachys*; (⊗) *H. insignis*; (□) *Odontohenricia aurantia*; (æ) *O. ahearnae*; (*) *O. violacea*.

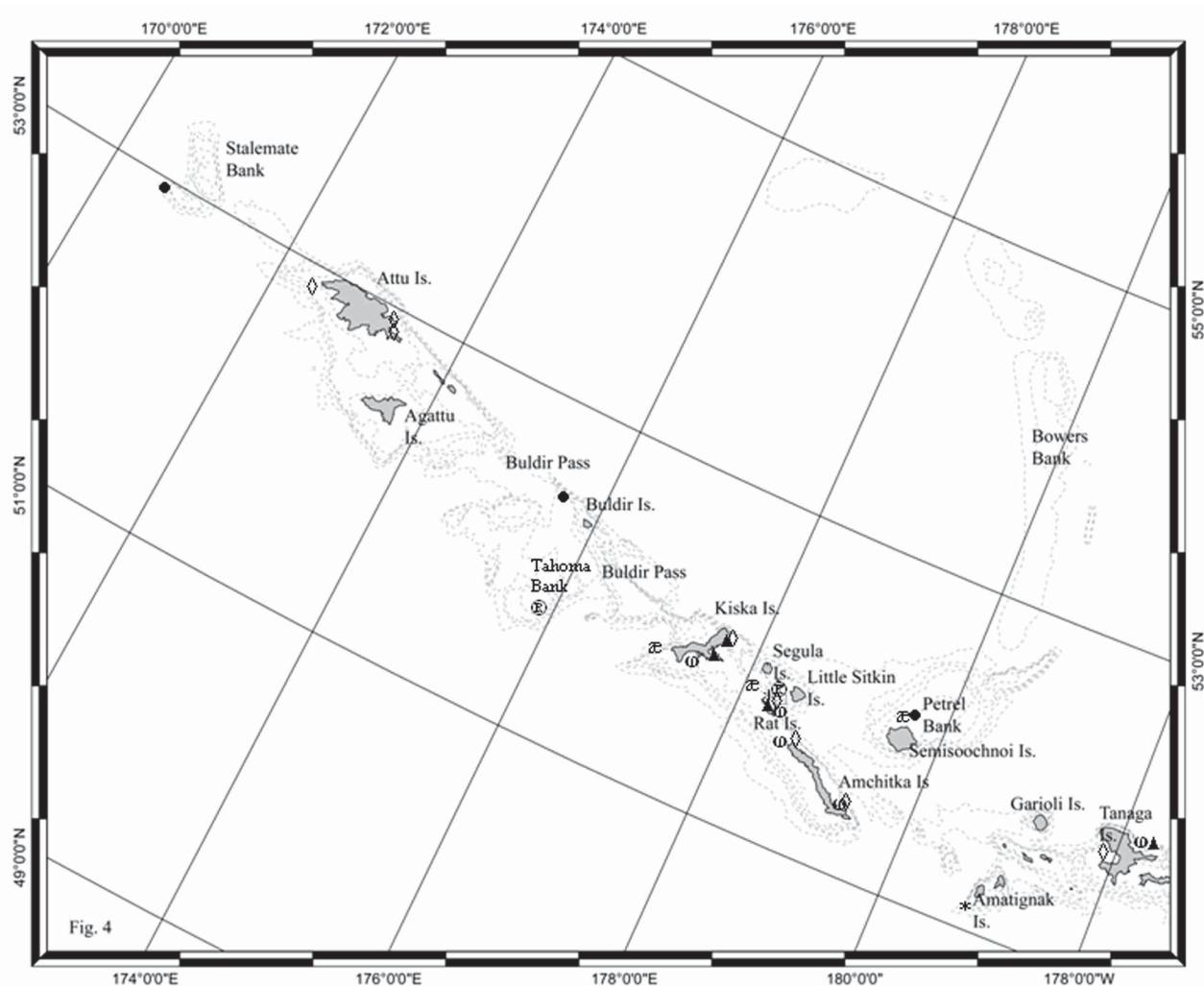


FIGURE 4. Western Aleutian Islands, Tanaga Island to Stalemate Bank. (●) *Aleutihenricia federi*; (◊) *Henricia lineata*; (○) *H. uluudax*; (▲) *H. iodinea*; (®) *H. rhytisma*; (■) *H. echinata*; (◆) *H. gemma*; (♥) *H. vermillion*; (+) *H. elachys*; (○) *H. insignis*; (□) *Odontohenricia aurantia*; (⊗) *O. ahearnae*; (*) *O. violacea*.

Taxonomic account

Asteroidea de Blainville 1830

Spinulosida Perrier 1884

Echinasteridae Verrill, 1870

Aleutihenricia gen. nov.

Five-rayed echinasterid sea stars; disc broad, rays inflated, moderately long and broad; skeleton thin, relatively soft; abactinal plates small, narrow, usually well spaced, in a lattice-like arrangement, and bearing spinose pseudopaxillar ridges; skeletal plates not arranged in discernable, linear series; marginal plates lacking or indistinguishable from abactinal and actinolateral plates; adambulacral plates with one spine deep in the ambulacral furrow, and many on the plate surface.

Type: *Henricia beringiana* D'yakonov, 1950

Aleutihenricia federi sp. nov.

Figures 5–11

Type locality: Alaska, Aleutian Islands, Andreanof Islands, Adak Island, Chapel Cove (51°38.5 N, 176°49.75 W), 24 m.

Type material: Holotype, USNM 1125115 (leg. R.N. Clark and Bob Lauth, 11 July, 1997; scuba 24 m); Paratype, LACM 2007-097.001, Alaska, Aleutian Islands, Andreanof Islands, Adak Island, Bay of Islands, off Green Island (51°49.023 N, 176°50.385 W) (leg. H. Chenelot, 9 July, 2007; scuba 16 m) (AKALE07-0005).

Additional material: 1, RNC, Aleutian Islands, Petrel Bank, off Semisopochnoi Island (52°04.112 N, 179°41.2 E) trawled R/V *Sea Storm*, 73 m (NMFS 143-200401-126) (leg. R.N. Clark, 7 July, 2004) (images DSC0124-126). 1, RNC, Aleutian Islands, Stalemate Bank, W of Attu Island (52°54.50 N, 170°49.26 E) trawled R/V *Dominator*, 219 m (leg. R.N. Clark, 2 August, 1997) (NMFS 23-971-210).

Diagnosis: Large inflated *Henricia*-like, R to 12 cm; disc small, rays long, broad, relatively soft; ridges of abactinal plates with 8–15 stout spinelets; marginal plates indistinguishable from actinal plates; adambulacral plates with nine or ten spines, grading smaller distally; color in life yellow with irregular maroon mottling.

Description: Large, inflated; disc broad, rays relatively long, broad; Holotype, R = 13.8 cm, r = 24 mm, R:r = 4.8:1 (Figs. 5,6 & 11). Abactinal and surface (Fig. 7) inflated, thin; plates small, narrower than papular areas, forming ridges in an irregular lattice-like arrangement (Fig. 8) crowned with 8–15 stout, rounded spinelets (to 0.5 mm in height), bearing numerous minute apical thorns; papular areas with one or two papulae and occasionally small plates; madreporite slightly closer to anus than disc edge; small, oval, with irregularly radiating spinose ridges. Marginal plates indistinguishable from abactinal and actinolateral plates, not arranged in discernable linear series; adambulacral plates (Fig. 9) with one small, deep furrow spine, a single large, compressed spine at the edge of the furrow, behind which are one to three similar but somewhat smaller spine(s), followed by series of six to nine still smaller spines. Oral plates (Fig. 10) with five stout, blunt compressed marginal spines, behind which are three smaller cylindrical submarginal spines and a group of six to nine smaller spines on the distal portion of the plate. Color in life (Fig. 11), yellow with irregular maroon blotches and speckles abactinally.

Distribution: Alaska, Aleutian Islands, Stalemate Bank, W of Attu Island (52°54.50 N, 170°49.26 E) (23-971-210) to Petrel Bank, off Semisopochnoi Island. (52°04.112 N, 179°41.2 E) (NMFS 143-200401-126), at 16 to 219 m. The distribution of *Aleutihenricia federi* is not fully understood, it may be an endemic Aleutian species.

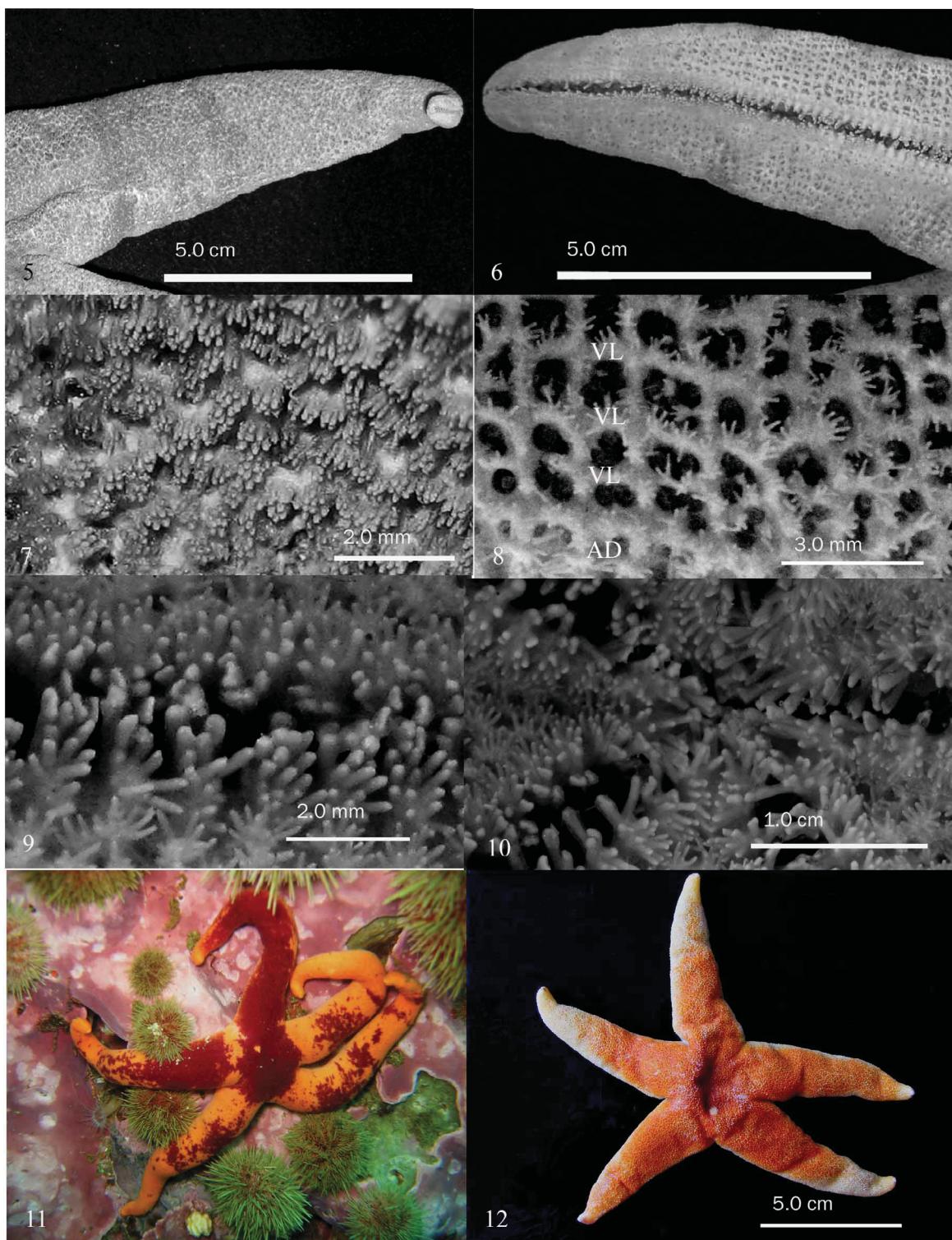
Habitat: Subtidal on boulders and bedrock typically covered with the thick, encrusting coralline red algae *Clathromorphum nereostratum* and sponges, with water temperatures of 4.6 to 5°C.

Etymology: It is with great pleasure that we name this species in honor of Dr. Howard M. Feder, Professor Emeritus, Institute of Marine Science, University of Alaska Fairbanks. During his long career, Dr. Feder has made numerous contributions to our understanding of sea stars. For more than fifty years he unselfishly mentored hundreds of students and marine biologists, passing on his knowledge and passion for the Alaska benthic marine ecosystem.

Remarks: *Aleutihenricia federi* is a member of a very unique group of *Henricia*-like Echinasteridae including *H. beringiana* (D'yakonov, 1950) (Fig. 12) (Bering Sea), *H. derjugini* (D'yakonov, 1950) (Fig. 13) (Bering and southern Chukchi Seas), *H. reticulata* (Hayashi, 1940) (Japan) and at least one other undescribed species from the western Aleutian Islands, all of which are herein considered members of the genus *Aleutihenricia*.

Aleutihenricia federi is similar to *A. beringiana* which occurs at similar depths in the Aleutians, but may be distinguished by 1) coloration, *A. beringiana* is usually nearly uniformly reddish in color; 2) spinelets of abactinal plates, six to nine in *A. beringiana*, 8–15 in *A. federi*; and 3) Adambulacral plates, which in *A. beringiana* bear seven or eight spines, compared to 9–12 in *A. federi*. *Aleutihenricia derjugini* differs in 1) Uniform white color and 2) 2–4 spinelets on abactinal plates.

Recently Dr. Megumi Strathmann Friday Harbor, Washington (*pers. com.* March, 2009) examined the type of *Henricia sanguinolenta rudis* Verrill, 1914 from the Alaskan Arctic, and indicated that it appears to be



FIGURES 5–10. *Aleutihenricia federi*, Holotype, USNM 1125115. Fig. 5, Ray, abactinal view. Bar = 5.0 cm. Fig. 6, Ray, actinal view. Bar = 5.0 cm. Fig. 7, Close-up, abactinal surface. Bar = 2.0 mm. Fig. 8, Close-up of actino-lateral surface of ray, near the base of the ray, illustrating arrangement of skeletal ossicles. (AD) adambulacrals; (VL) ventral laterals. Bar = 3.0 mm Fig. 9, Close-up of adambulacral region of ray. Bar = 2.0 cm. Fig. 10, Close-up of oral region. Bar = 1 cm.

FIGURE 11. *Aleutihenricia federi*, Paratype, LACM 2007-097.001, live, *in situ* off Green Island, Bay of Isles, Adak Island (AKALE07-0005), depth 16 m (image: Héloïse Chenelot, 9 July, 2007). R = approximately 8 cm.

FIGURE 12. *Aleutihenricia beringiana*, live animal, Amutka Pass, Aleutian Islands (52°02.503 N, 172°15.08 W) (NMFS 94-0201-194) trawled R/V *Vesteraalen*, 169 m (leg. R. Clark, 18 July, 2002). Bar = 5.0 cm.

in this genus also, and that it may even be con-specific with *A. beringiana*, a re-study of Verrill's original description confirms that it very likely is a member of *Aleutihenrica*, but it's possible con-specificity with *A. beringiana* cannot yet be determine. There was no opportunity to examine the type of *A. rufus* at the time of this study.

***Henricia* Gray, 1840**

Five-rayed Echinasteridae with open or close meshed skeleton bearing numerous small spinelets either in groups or scattered along the ridges composing the skeleton; marginal plates distinguishable from abactinal plates, usually obvious; adambulacral plates with one or more spinelets deep in the ambulacral furrow (modified from Fisher, 1911).

Type: *Asterias oculata* Pennant, 1777 (by original designation)

***Henricia lineata* sp. nov.**

Figures 14–19

Henricia leviuscula spiculifera (Clark) Verrill, 1914: 232 (pars), non *Cribrella spiculifera* H. L. Clark, 1901.

Henricia spiculifera (H. L. Clark) D'yakonov, 1950: 87 (pars), non *Cribrella spiculifera* H. L. Clark, 1901.

Henricia sp. A, R.N. Clark. www.jaxshells.org/henricia2.htm

Type locality: Alaska, Aleutian Islands, Near Islands, Attu Island, Chichagof Harbor (52°55.861 N, 173°15.295 E), 7 m.

Type material: Holotype, LACM 2007-027.001 (leg. R.N. Clark, 4 June, 2008; scuba 7 m) (AKALE07-0019); 2 Paratypes, LACM 2007-027.002; 2 Paratypes, USNM 1125118 (Type locality); 2 Paratypes, CASIZ 180535 (Type locality); Paratype, UAM 8132, Alaska, Aleutian Islands, Rat Islands, Rat Island (51°49.594 N, 178°27.184 E) (leg. R.N. Clark, 1 July, 2007; scuba 9 m); Paratype, LACM 2007-028.001, Alaska, Aleutian Islands, Fox Islands, Avatanak Island (54°05.188 N, 165°22.839 W) (leg. R.N. Clark, 12 June, 2008; scuba 6 m).

Diagnosis: Relatively small, fairly rigid, R to 7 cm; disc small, rays moderately long, slender, tapering. Abactinal plates close-set, forming a tight reticulation, very spinose. Abactinal surface with three radial rows per ray of very tightly packed spinose plates forming conspicuous lines; similar rows of tightly packed or fused plates at ray arcs, forming internal septa; color in life red with lighter radial lines.

Description: Relatively small, R to 6 cm (Holotype R = 5.7 cm), r to 1.2 cm, R:r 5–6:1 (Figs. 14 & 15); disc small, rays moderately long, slender, sub-cylindrical, tapering to blunt tips. Abactinal surface (Fig. 16) thick, semi-rigid; abactinal plates relatively small, close set, forming a tight reticulation some plates very close set or fused into linear series, lacking papular areas between, forming three distinct lines on rays, similar linear series of plates at ray arcs, forming internal septa; plates crowned with 9–35 spinelets tipped with 3–8 very sharp thorns; papular areas rather small, with 1–3 papulae; madreporite small, circular, spinose, located about half way between anus and edge of disc, at the end of the ray arc linear plate series. Superomarginals slightly larger than abactinal plates, inferomarginals about twice high as high as long; twice as large as abactinal plates and bearing 40–50 spine tipped spinelets; a single series of intermarginals extends about 1/3 to 1/2 of R; a primary actinal inter-radial series extends about 90% of R, a second series extends about 1/4 to 1/2 of R. Adambulacra (Fig. 17) with a single deep furrow spine and 14–17 actinal spines, one to three longer and somewhat compressed spine(s) at furrow edge, and 13–15 smaller distally grading spines behind. Oral plates (Fig. 18) five marginal and four to six suboral spines; in addition there are two to four thick, blunt, triangular, teeth deep in the furrow near the distal edge of the plate. Color in life (Fig. 19), red abactinally, with pale red to yellow-orange radial lines; orally yellow-orange. Dried specimens retain the lined pattern.

Distribution: Found throughout the Aleutians from Fox Islands Avatanak Island, (54°05.188 N, 165°22.839 W) (leg. R.N. Clark, 12 June, 2008; scuba 6 m) to Near Islands, Attu Island, Chichagof Harbor

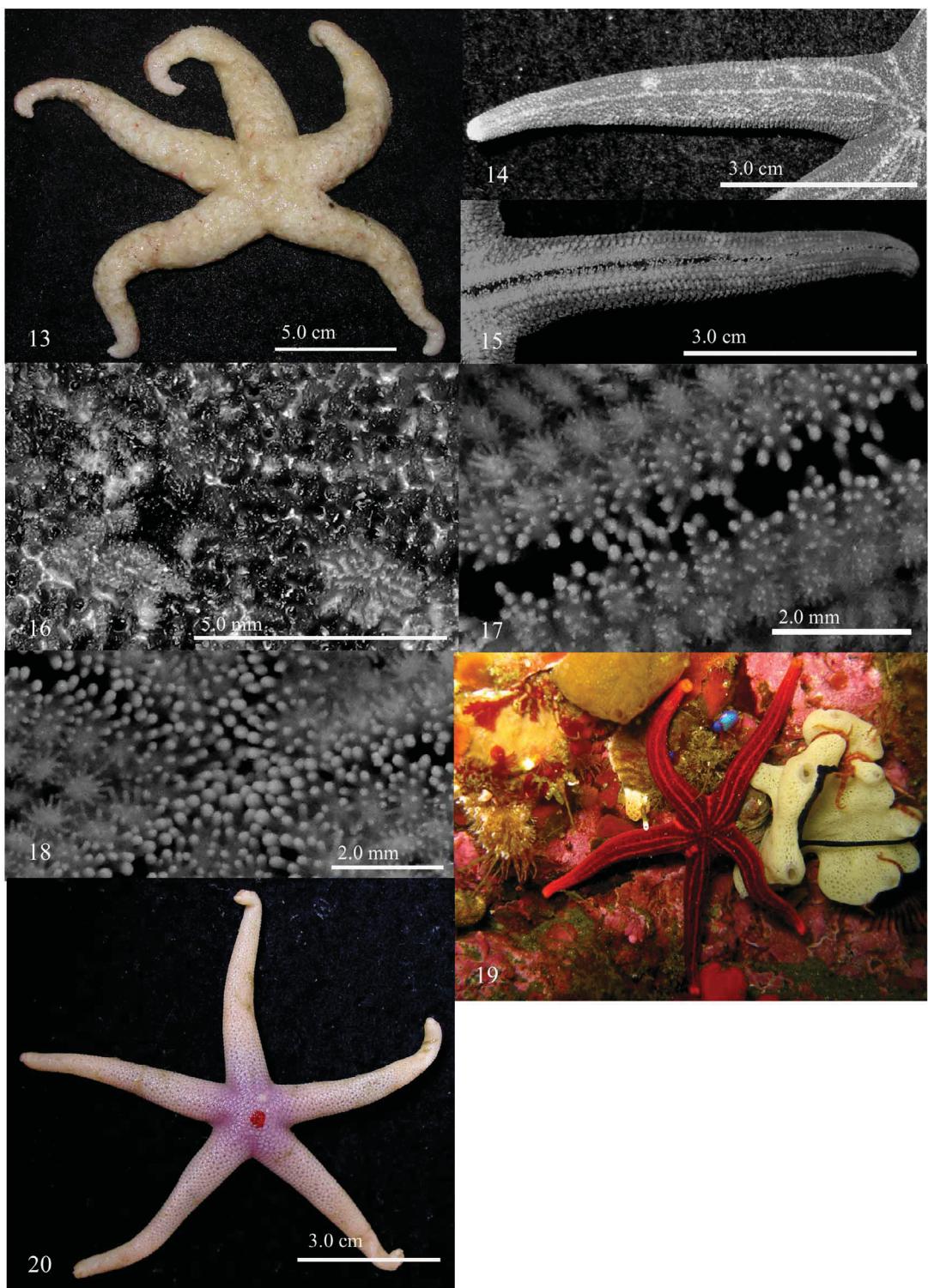


FIGURE 13. *Aleutihenricia derjugini*, live animal, Stalemate Bank, W of Attu Island ($53^{\circ}18.839\text{ N}$, $170^{\circ}43.34\text{ E}$) (NMFS 147-0401-224) trawled R/V *Gladiator*, 359 m (leg. R. Clark, 31 July, 2004). Bar = 5.0 cm.

FIGURES 14–18. *Henricia lineata*, Holotype, LACM 2007-027.001. Fig. 14, Ray, abactinal view. Bar = 3.0 cm. Fig. 15, Ray, actinal view. Bar = 3.0 cm. Fig. 16, Close-up of abactinal surface. Bar = 5.0 mm. Fig. 17, Close-up of adambulacral region of ray. Bar = 2.0 mm. Fig. 18, Close-up of oral region. Bar = 2.0 mm.

FIGURE 19. *Henricia lineata*, live *in situ*., Rat Island, 14 m (image: R. Clark, 8 June, 2008). R = approximately 5 cm.

FIGURES 20. *Henricia multispina*, live animal, E of Attu Island ($52^{\circ}49.568\text{ N}$, $173^{\circ}41.51\text{ E}$) (NMFS 147-0401-208) trawled R/V *Gladiator*, 117 m (leg. R. Clark, 27 July, 2004). Fig. 20, Whole animal, abactinal view. Bar = 3 .0 cm.

(52°55.861 N, 173°15.295 E) (leg. R.N. Clark, 4 June, 2008; scuba 7 m) (Type locality) at depths of 6–25 m. Also present at Bering Island, Commander Islands, Russia (55°11'44" N, 165°59' E) (per. com. Ken Vicknair, April, 2008), and along the Kamchatka, Russia coast (www.sanamyan.com). *Henricia lineata* is a member of the Aleutian Province, but the extent of its amphi-Pacific distribution requires further investigation.

Habitat: Subtidal boulders and bedrock covered with the thick encrusting coralline red algae *Clathromorphum*.

Etymology: Named for the brilliant red stripes on the rays.

Remarks: This species has long been confused with the similar *Henricia multisepia* Fisher, 1910 (Fig. 20), under the mistaken identification of *Henricia spiculifera* (H.L. Clark, 1901). This latter species has not been identified since Clark's time. Clark's description differs on various points from that of *H. multisepia*, and the type was from the vicinity of Puget Sound, Washington. An attempt to locate the type of *H. spiculifera* was unsuccessful, and it is presumed lost. It is therefore recommended that this name be treated as *nomen inquirendum* until the type or material from near the type locality that fits the original description can be located. *Henricia lineata* may be distinguished from *H. multisepia* by 1) the prominent series of close-set aboral plates forming distinctive lines on the abactinal surface; 2) much smaller aboral plates; 3) relatively shorter, thicker, blunt-tipped rays, those of *H. multisepia* are much more slender and pointed at the tips; and 4) dark reddish color, compared to white or pale lavender for *H. multisepia*.

Henricia uluudax sp. nov.

Figures 21–26

Henricia spiculifera (Clark) Verrill, 1914: 232 (pars), non *Cribrella spiculifera* H.L. Clark, 1901.

Henricia leviuscula multisepia Fisher, 1911: 286 (pars), non *Henricia leviuscula multisepia* Fisher, 1910: 571.

Type locality: Alaska, Aleutian Islands, Fox Islands, Unalaska Island, NW entrance to Unalaska Bay, inside Eider Point (53°57.33 N, 166°35.5 W), 5 m.

Type material: Holotype, LACM 1999-178.001 (leg. R.N. Clark, 9 May, 1999); 1 Paratype, USNM 1125119 (leg. R.N. Clark, 9 May, 1999); 1, CASIZ 180536 (leg. R.N. Clark, 1999).

Material examined: 2, LACM 1997-219.001, Atka Island, Crescent Bay, point at W end, 10 m (leg. R.N. Clark & Robert Lauth, 8 July, 1997); 2, RNC, Unalaska Island, Eider Point, 0–5 m (leg. R.N. Clark, 2 October, 2001); 1, RNC, Seguam Island, 12 m (leg. Shawn Harper, 18 July, 2007); 2, LACM 2008-029.001, Avatanak Island, 6 m (leg. R.N. Clark, 12 June, 2008).

Diagnosis: Relatively small, fairly rigid, R to 5.3 cm (Holotype R = 4.5 cm), r to 10 cm, R:r 5–5.3; disc small, rays moderately long, slender, tapering. Abactinal plates small, close-set; some plates may form a single fine, faint medial line or ridge on the rays. Adambulacrals with 19–24 fairly stout, compressed spines.

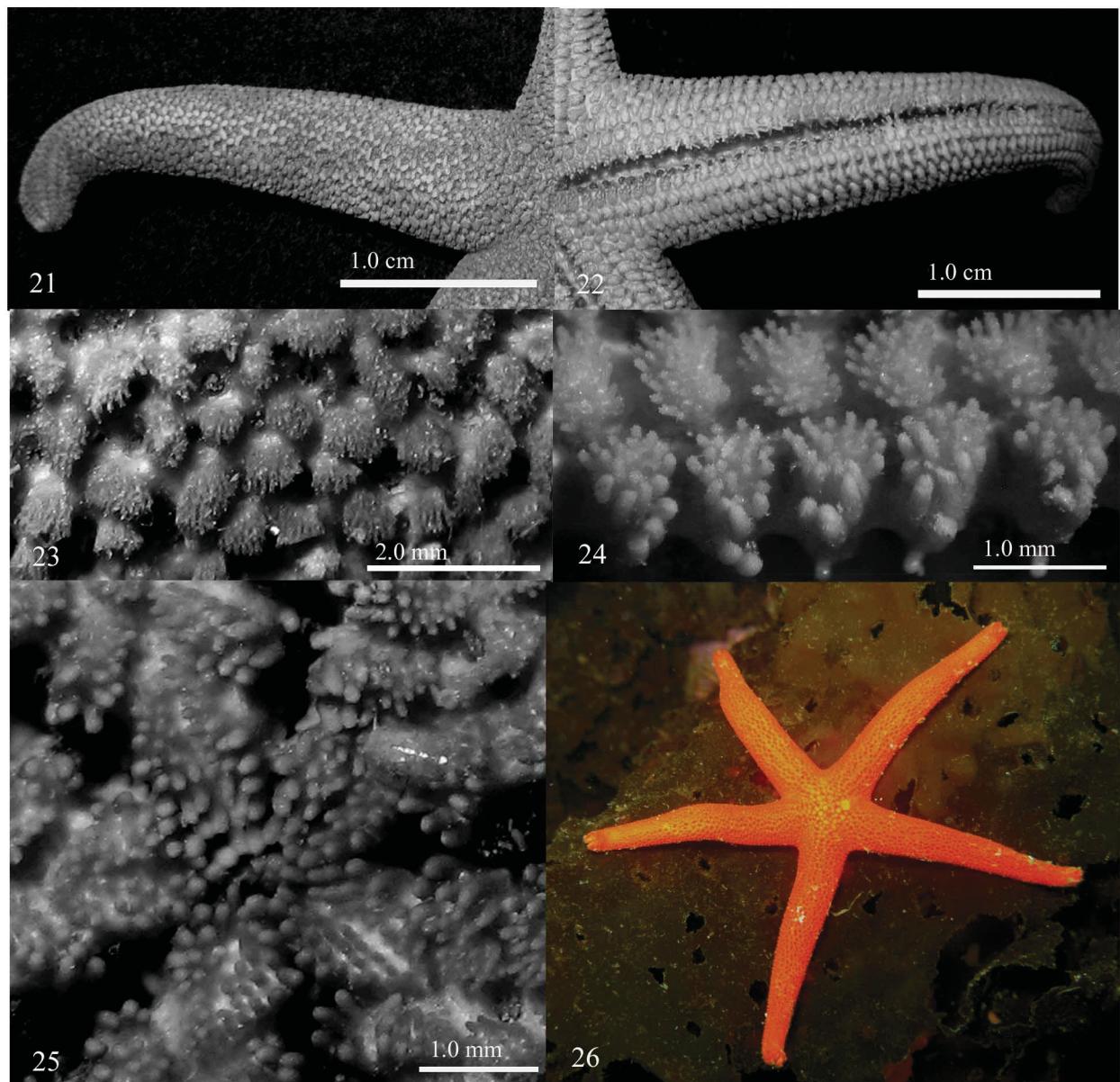
Description: Relatively small, R to 5.3 cm, r to 1.0 cm, R:r 5–5.3; disc small, rays moderately long, slender, tapering to fairly blunt tips (Figs. 21 & 22). Abactinal plates very small, close-set (Fig. 23); pseudopaxillae round on disc, becoming triangular on rays, forming a tight reticulation, some apical plates often very close-set, nearly coalescing, forming a single very fine line or ridge at apex of ray; plates crowned with 37–60 fine, divergent, thorn-tipped spinules, about 0.25 to 0.30 mm in length; usually 3 slender thorns per spinule; papular areas rather small, with 2–3 papulae; madreporite small, circular, irregularly radially spinose, located about 1/3 of the distance between the anus and the edge of the disc. Superomarginals 2 or 3 times as large as abactinal plates; inferomarginals about 1/3 third larger than superomarginals, and bearing 60–70 thorny spinules; first intermarginal series about 1/2 as large as inferomarginals at base of rays, grading smaller aborally, extending about 40–50% of R, second series ends just pass the base of the rays; actinal interradial series extending 75–80% of R. Adambulacrals (Fig. 24) with a single deep furrow spine, and 19–24 actinal spines, one (or two) large, thick, blunt spines at edge of furrow, backed by 2–3 similar spines, followed by a group of 16–20 smaller spines behind (usually arranged in 3 rows). Oral plates (Fig. 25) with 3–4 thick, blunt marginal spines, and 6–9 similar, sub-oral spines; in addition there are two to four thick, blunt,

triangular, teeth deep in the furrow near the distal edge of the plate. Color in life (Fig. 26) uniformly bright red.

Distribution: Found from Fox Islands, Avatanak Island ($54^{\circ}05.188'N$, $165^{\circ}22.839'W$) (leg. R.N. Clark, 12 June, 2008) to Andreanof Islands, Atka Island, Crescent Bay, point at W end (leg. R.N. Clark & Robert Lauth, 8 July, 1997) at depths of 0–12 m. *Henricia uluudax* appears to be an endemic Aleutian species.

Habitat: Intertidal and shallow subtidal, on cobbles and boulders encrusted with coralline red algae. Frequently in kelp beds [*Eualaria* (*Alaria*) *fistulosa* and *Nereocystis luetkeana*].

Etymology: The name is the Aleut native word for red; (pronounced *ōō lōō thux*).



FIGURES 21–26. *Henricia uluudax*, Holotype, LACM 1999-178.001. Fig. 21, Ray, abactinal view. Bar = 1.0 cm. Fig. 22, Ray, actinal view. Bar = 1.0 cm. Fig. 23, Abactinal surface. Bar = 2.0 mm. Fig. 24, Adambulacral region. Bar = 1.0 mm. Fig. 25, Oral region. Bar = 1.0 mm. Figure 26, *Henricia uluudax*, live animal, Type locality, 5 m. R = 5.0 cm (image: R. Clark, 15 June, 2008).

Remarks: *Henricia uluudax* is very similar superficially to *H. lineata*, but may be distinguished by 1) the lack light colored lines of coalescing plates; 2) more numerous abactinal spinules, 37–60, compared to 18–41; 3) more numerous inferomarginal spines, 60–70, opposed to 28–36; and 4) more numerous adambulacral spines, 19–24 compared to 15–17. The spinose nature of this form led Fisher (1911) to consider this an

"extreme variant" of *H. multispinosa*, and Verrill thought it to be (at least in part) H.L. Clark's *Cribrella spiculifera*.

It differs from the similar appearing *H. vermillion* by 1) the slender body; 2) differently shaped abactinal plates; 3) much more slender, divergent pseudopaxillar spinules, which bear (usually) just 3 long thorns, those of *H. vermillion* are pointed and bear numerous thorns, 4) the much more numerous adambulacral spines, 19–24 as opposed to 7–10 in *H. vermillion*; and 5) presence of extensive intermarginal series.

From the southern *H. leviuscula*, it differs in having slender, divergent, 3-pronged abactinal spinules, and an intermarginal series extending to about 50% of R, *H. leviuscula* lacks an intermarginal series. True *H. leviuscula* is not known to occur north of extreme southeastern Alaska (Doug Eernisse, *pers. comm.*, March, 2009). This species is part of a complex of several very similar appearing *Henricia* in the Aleutians.

***Henricia iodinea* sp. nov.**

Figures 27–32

Type locality: Alaska, Aleutian Islands, Rat Islands, Rat Island (51°49.594 N, 178°27.184 E), 14 m. (AKALE07-A0031).

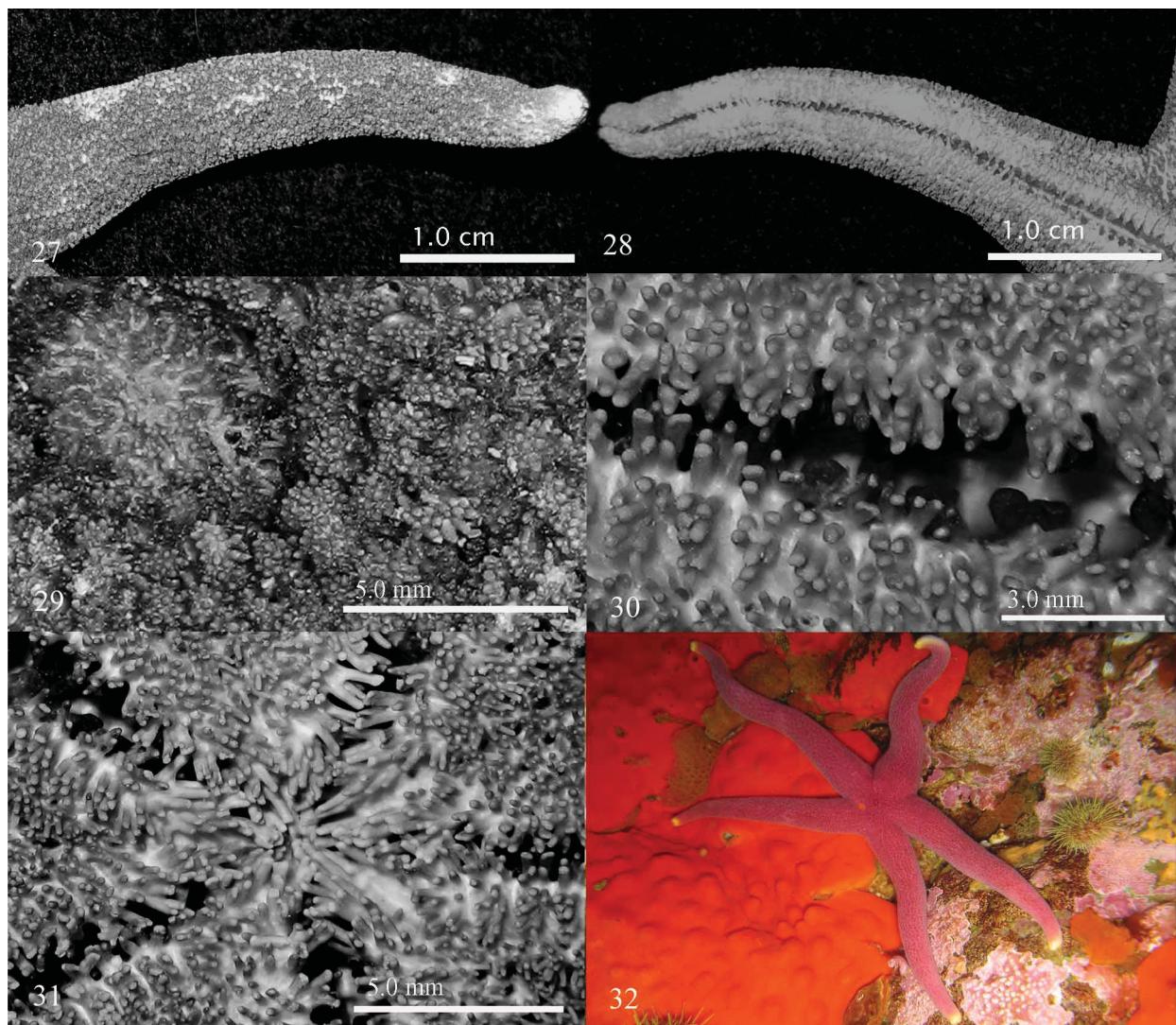
Type material: Holotype, LACM 2007-099.002, and 3 Paratypes, LACM 2007-099.003 (*leg.* R.N. Clark, 1 July, 2007; scuba 14 m); Paratype, USNM 1125117 (Type locality); Paratype, CASIZ 180538 Alaska, Aleutian Islands, Fox Islands, Avatanak Island (54°05.188 N, 165°22.839 W) (*leg.* R.N. Clark, 12 June, 2008; scuba 6 m); Paratype, UAM 8133 Alaska, Aleutian Islands, Islands of the Four Mountains, Carlisle Island (52°53.973 N, 169°59.730 W) (*leg.* R.N. Clark, 15 July, 2006; scuba 7 m) (AKALE06-0011).

Diagnosis: Relatively large, R to 16 cm (Holotype R = 5.3 cm), R:r 5.1:1; rough textured; disc relatively small, rays long, slender, tapering. Abactinal plates small, irregular, forming a fairly open reticulation in small animals, but quite tight in larger individuals; plates crowned with tight bundles of blunt-tipped spinelets. Marginals widely separated at base of rays; superomarginals slightly larger than abactinals, forming a distinctive ridge that curves up aborally at the base of the rays. Adambulacrals with nine to 12 spines. Color in life purple or violet abactinally, paler orally.

Description: Moderately large, R to 10.5 cm, r to 1.9 cm, R:r 5.1:1 (Figs. 27 & 28); disc relatively small, rays long, slender, tapering. Abactinal plates (Fig. 29) small (somewhat larger on disc), irregular, forming tight reticulation in large specimens, crowned with bundles of 20–30 short (to 0.5 mm), apically spinose, bluntly rounded spinelets; some plates slightly enlarged and spaced more closely together, forming irregular vermiform ridges, giving a rough texture. Madreporite small, circular and spinose. Marginal plates, widely separated at base of rays, supromarginal row somewhat larger than abactinals, sloping up prominently aborally at base of rays; intermarginals numerous (up to 10 rows) and small at ray arches, and proximal 1/5 of ray, diminishing to three irregularly staggered rows by just past mid ray, and finally a single irregular row which extends to about 80% of R; inferomarginals nearly twice as large as abactinals, about twice as high as wide; actinal interradials in two rows, submarginal row ending proximal to 1/3 of R, larger subadambulacral row, about as large or larger than inferomarginals extending to near ray tips. Adambulacrals (Fig. 30) with a single deep furrow spine; actinal series with blunt tipped, sometimes bifurcate spines, one spine at the edge of the furrow, behind which are two slightly smaller spines followed by a group (usually three rows) of 9 to 12 smaller spines. Oral plates (Fig. 31) with marginal series of four thick blunt, sometimes bifurcate spines, and four to ten smaller suboral spines. Color in life (Fig. 32), lavender, purple or violet abactinally, with yellowish ray tips rarely uniformly pale, pinkish lavender; actinal side paler.

Distribution: Alaska, Aleutian Islands, Fox Islands, Avatanak Island (54°05.188 N, 165°22.839 W) (*leg.* R.N. Clark, 12 June, 2008; scuba 6 m) to Rat Islands, Rat Island (51°49.594 N, 178°27.184 E) (*leg.* R.N. Clark, 1 July, 2007; scuba 14 m) (AKALE07-A0031), at depths of 5–20+ m. *Henricia iodinea* is a member of the Aleutian Province.

Habitat: Subtidal boulders and bedrock, typically on substrate with patches of large, encrusting brownish-yellow or red-orange sponges of unknown identity and various type of red algae.



FIGURES 27–28. *Henricia iodinea*, Holotype, LACM 2007-099.002. Fig. 27, Ray, abactinal view. Bar = 1.0 cm. Fig. 28, Ray, actinal view. Bar = 1.0 cm.

FIGURES 29–31. *Henricia iodinea*, Paratype, LACM 2007-099.003. Fig. 29, Close-up, abactinal surface. Bar = 5.0 cm. Fig. 30, Close-up, adambulacratal region. Bar = 3.0 cm. Fig. 31, Close-up, oral region. Bar = 5.0 cm.

FIGURE 32. *Henricia iodinea*, live *in situ*, Kiska Island (AKALE07-A0084), 11 m (image: Reid Brewer, 30 June, 2007). R = approximately 7 cm.

Etymology: The name is from the Greek *iodes*, "violet-like in color", in reference to the vibrant purplish-violet or lavender abactinal coloration.

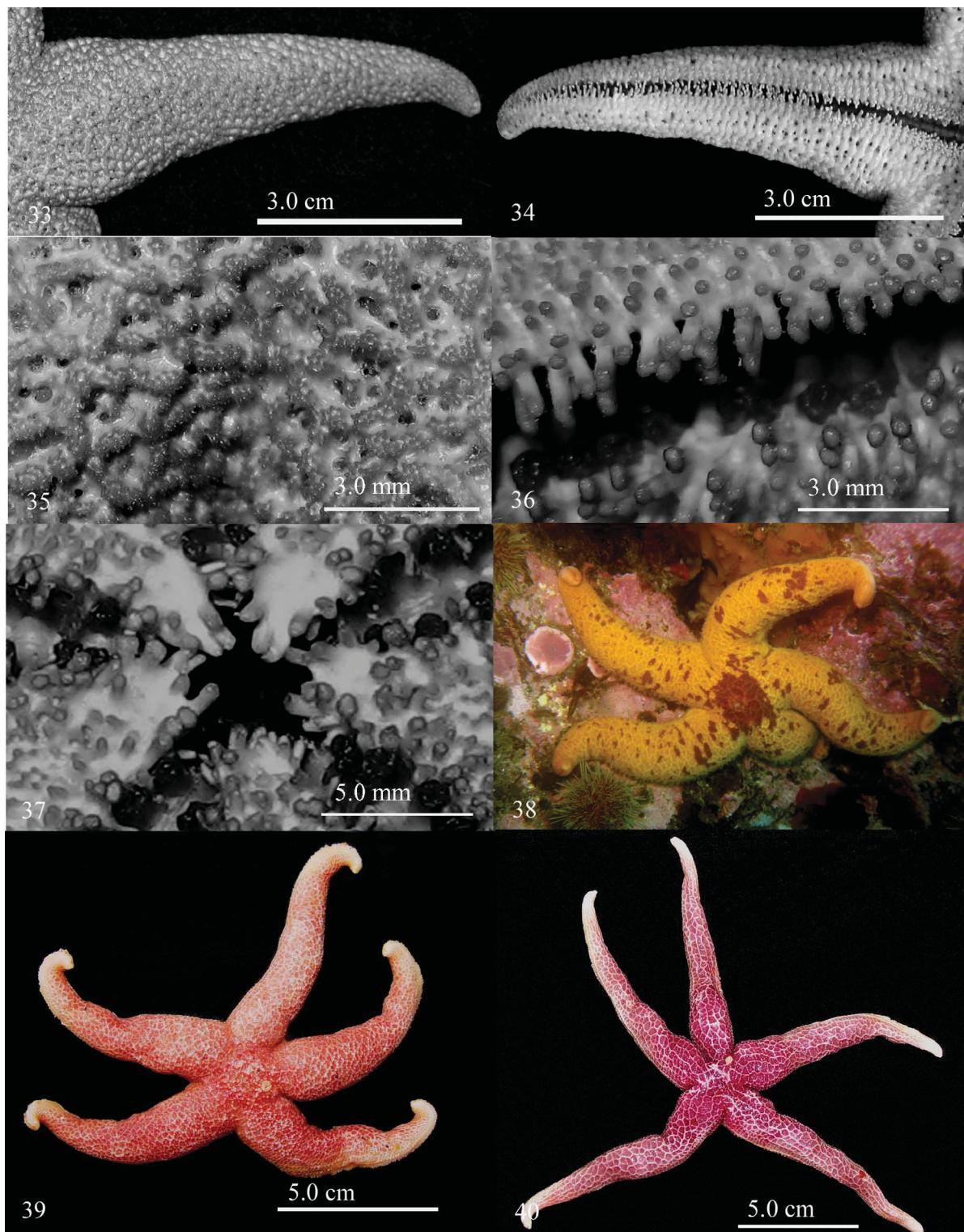
Remarks: This species is remarkable for the rough texture, and purplish aboral coloration as well as the distinctive superomarginal series, and is unlikely to be confused with other *Henricia*.

Henricia rhytisma sp. nov.

Figures 33–38

Henricia sp. C, Clark, 2007. www.jaxshells.org/henricia2.htm

Type locality: Alaska, Aleutian Islands, Little Sitkin Island, near Finger Point (51°58.201 N, 178°27.184 E), 11 m. (AKALE07-0045).



FIGURES 33–37. *Henricia rhytisma*, Holotype, LACM 2007-101.001. Fig. 33, Ray, abactinal view. Bar = 3.0 cm. Fig. 34, Ray, actinal view. Bar = 3.0 cm. Fig. 35, Close-up, abactinal surface. Bar = 3.0 mm. Fig. 36, Close-up, adambulacral region. Bar = 3.0 mm. Fig. 37, Close-up, oral region. Bar = 5.0 mm.

FIGURE 38. *Henricia rhytisma*, live, *in situ*, Little Sitkin Island (AKALE07-0045), 11 m (image: Reid Brewer, 1 July, 2007). R = approximately 8 cm.

FIGURE 39. *Henricia asthenactis*, live animal, S of Atka Island (51°51.467 N, 174°09.4 W) (NMFS 94-0201-151) trawled R/V *Vesteraalen*, 152 m (leg. R. Clark, 10 June, 2002). Bar = 5.0 cm.

FIGURE 40. *Henricia aspera*, live animal, Buldir Reef (51°52.124 N, 177°42.45 E) (NMFS 143- 0401-141) trawled R/V *Sea Storm*, 107 m (leg. R. Clark, 10 July, 2004). Bar = 5.0 cm.

Type material: Holotype, LACM 2007-101.001; Paratype, USNM 1125122. Both specimens from the type locality (leg. Reid Brewer, July, 2007; scuba 11 m)

Material examined: 1, Avatanak Island (54°05.188 N, 165°22.839 W) (leg. R.N. Clark, 12 June, 2008; scuba 6 m); 4, Tahoma Bank, SSE of Buldir Island (52°12.141 N, 176°12.69 E; NMFS 143-200401-158) (leg. R.N. Clark, 14 July, 2004; trawled, R/V *Sea Storm*, 91 m)

Diagnosis: moderately large, robust, fairly rigid, R to 8.0 cm (Holotype R = 7.9 cm), R:r 5; disc broad, thick, ray thick, inflated at base, tapering to slender tips; abactinal plates with 8–30 short, thick thorny spinelets; adambulacral plates with 8 to 10 thick blunt spines, 1 or 2 at furrow edge largest and usually slightly compressed. Color in life mottled, maroon on tan, cream, orange, yellow or lavender.

Description: Moderately large, robust, relatively rigid, R to 8.0 cm, r to 1.6 mm, R:r 5 (Figs. 33 & 34); disc broad, thick, rays inflated at base, sharply tapering to slender tips; abactinal plates (Fig. 35), thick, about as broad as papular areas and crowned with up to 25–30 short, stout, thorn tipped-spinelets, forming a fairly rigid, open, irregular reticulation; papular areas with one to three papulae per area; madreporite small, inconspicuous, somewhat closer to anus than disc margin, with subradiating, spinose ridges. Marginal plates larger than abactinal plates, but rather inconspicuous, superomarginals alternating with a series of small, intermarginals to about mid ray, second series of intermarginals extending about 75% of R, inferomarginals large, but inconspicuous, basal series of small actinal interradials often coalescing with them, a primary series of actinal interradials extends along distal to the adambulacrals, to about 3/4 of R; adambulacrals (Fig. 36) with one deep furrow spine, one or two large, thick, blunt, often compressed spine at edge of furrow, backed by two slightly smaller, similar spines, and four to six smaller, blunt spines in two series or a single staggered series. Oral plates (Fig. 37) with four or five short, thick, blunt marginal spines and one to four very short, thick suboral spines. Color in life (Fig. 38), variable, cream, orange, yellow or lavender with a few patches of dark red-brown or maroon abactinally, uniformly pale yellow or cream orally.

Distribution: Alaska, Aleutian Islands, Fox Islands, Avatanak Island (54°05.188 N, 165°22.839 W) (leg. R.N. Clark, 12 June, 2008; scuba 6 m) to Tahoma Bank, SSE of Buldir Island (52°12.141 N, 176°12.69 E; NMFS 143-200401-158) (leg. R.N. Clark, 14 July, 2004; trawled, R/V *Sea Storm*, 91 m) at depths of 6–91 m with a water temperature of 4.2–5°C. *Henricia rhytisma* appears to be endemic to the Aleutian Islands.

Habitat: Subtidal on boulders and bedrock, in areas with high concentrations of sponges, and a moderate current. Frequent in kelp beds [*Eualaria* (*Alaria*) *fistulosa*, and *Nereocystis luetkeana*] in shallow water (<20 m). On rocky substrates in deeper water.

Etymology: From the Greek noun, for patch, in reference to the aboral color pattern.

Remarks: *Henricia rhytisma* resembles both *Henricia asthenactis* Fisher, 1910 (Fig. 39) and *Henricia aspera* Fisher, 1906 (Fig. 40), with which it co-occurs, all three species having an open reticulation and few adambulacral spines, however the number of the spines, shorter, thicker rays and distinctive coloration distinguish it. The aboral spines of *H. asthenactis* are relatively long, stout, and sheathed with thick fleshy skin; those of *H. aspera* are low, stout and unsheathed. Additionally the spines of both of the latter species occur in a single row. The abactinal coloration of *H. asthenactis* is solid purple, and *H. aspera*, is uniformly pale orange, cream or purple.

Morphologically *H. rhytisma* is very similar to the Arctic-circum-boreal *H. oculata* (Fig. 41), but differs in having 1) more numerous abactinal pseudopaxillar spinelets, 25–30+ compared to 20 (very rarely to 25) in *H. oculata*; and 2) more numerous adambulacral spines, 1–2 (at furrow edge)+ 2+4–6 in two rows or a single staggered row, compared to 1+3–5 in a single irregular row.

Henricia echinata spec. nov.

Figures 42–46

Type locality: Alaska, Aleutian Islands, Andreanof Islands, Adak Island, Bay of Isles (51°49.023 N, 176°50.385 W), 13 m. (AKALE07-0005).

Type material: Holotype, LACM 2007-098.001 (leg. R.N. Clark, 1 July, 2007).

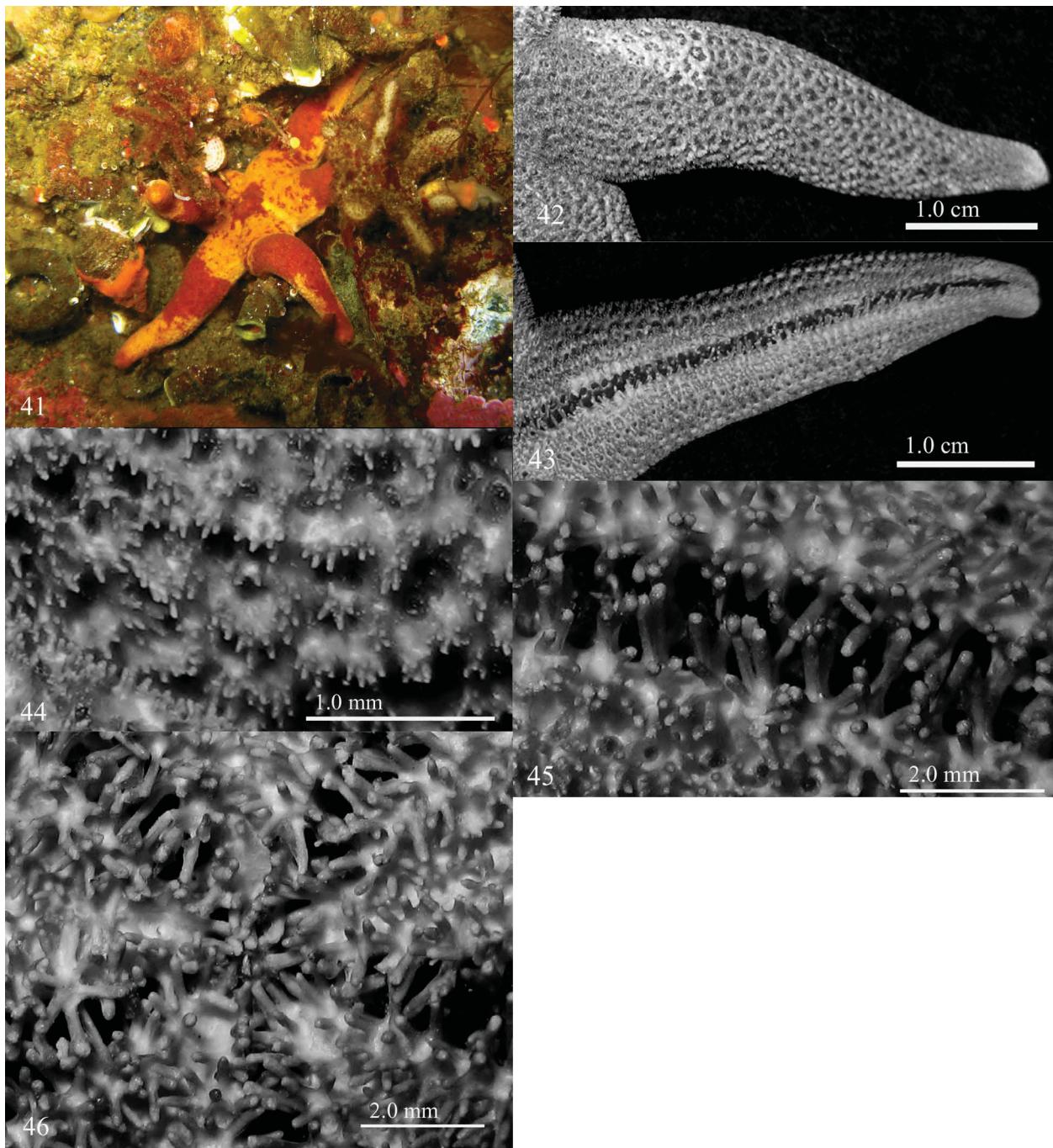


FIGURE 41. *Henricia oculata*, live, *in situ*, Akun Island, 11 m (image: R. N. Clark, June, 2008).

FIGURES 42–46. *Henricia echinata*, Holotype, LACM 2007-098.001. Fig. 42, Ray, abactinal view. Bar = 1.0 cm. Fig. 43, Ray, actinal view. Bar = 1.0 cm. Fig. 44, Close-up, abactinal surface. Bar = 1.0 mm. Fig. 45, Adambulacral region. Bar = 2.0 mm. Fig. 46, Oral region. Bar = 2.0 mm.

Diagnosis: Small, moderately inflated, R to 5.3 cm, R:r 4.8; abactinal skeleton irregular, open meshwork; abactinal plates with 5–11 blunt rather smooth spines; adambulacrals with 8–11 slender, blunt spines, 1 at furrow edge, followed by 2 slightly shorter spines, and 2 irregular rows of 3–4 shorter shorter spines; oral plates with 4–5 marginal and 1 or 2 sub-oral spines; Color in life, red.

Description: Small, moderately inflated, R 5.5 cm, r 1.1 cm, R:r 5.0 cm (Figs. 42 & 43); disc small, rays relatively short, tapering to slender, blunt tips. Abactinal plates forming an irregular, open reticulation (Fig. 44); pseudopaxillae bearing 5–11 short, thick, blunt, smooth spines in two irregular rows; spines to about 0.2

mm long; madreporite small, with irregular spinose ridges; papular area large, with 2–4 papulae per area. Superomarginals about 2–3 times larger than abactinals, and bearing 9–15 spines; intermarginals about half as large as superomarginals, and forming an irregular series extending 35–50% of R; inferomarginals about 1/3 larger than superomarginals, chevron-shaped and bearing 15–21 spines. Actinal interradial plates less than 1/2 the size of inferomarginal, in a series extending about 75% of R, and bearing 7–12 spines. Adambulacrals (Fig. 45) with a single slender, deep furrow spine, 1 long slender spine at furrow edge backed by 2 similar but somewhat shorter spines, and then 2 rows of 3–4 shorter spines. Oral plates (Fig. 46) with 4–5 long, thick, blunt marginal spines, and 1–2 similar, slightly shorter sub-orphals. Color in life uniformly reddish.

Distribution: Alaska, Aleutian Islands, Andreanof Islands, Adak Island, 16 m. Known so far only from the central Aleutians, the Holotype at Adak Island, and an image of a second specimen from Amchitka Island. Further investigation is needed to define the limits of distribution for *Henricia echinata*, but it may be endemic to the central Aleutians.

Habitat: Rocky substrate with encrusting coralline algae and sponges.

Etymology: From the Latin, for prickly.

Remarks: *Henricia echinata* is somewhat similar in general appearance to *H. asthenactis* (Fig. 39), but differs in 1) having the abactinal spines in 2 rows, and lack the thick fleshy membrane; and 2) adambulacrals spines in 2 rows. It bears superficial resemblance to *H. rhytisma*, but is readily separated by the relatively long, smooth abactinal spines. *Henricia echinata* also resembles the Arctic-Atlantic *Henricia perforata* (Müller, 1776), but differs in having much shorter (0.2 mm compared to 0.5–0.7 mm) spines, which are stout and blunt. The spines of *H. perforata* are slender and pointed (Madsen, 1987).

Henricia gemma spec. nov.

Figures 47–52

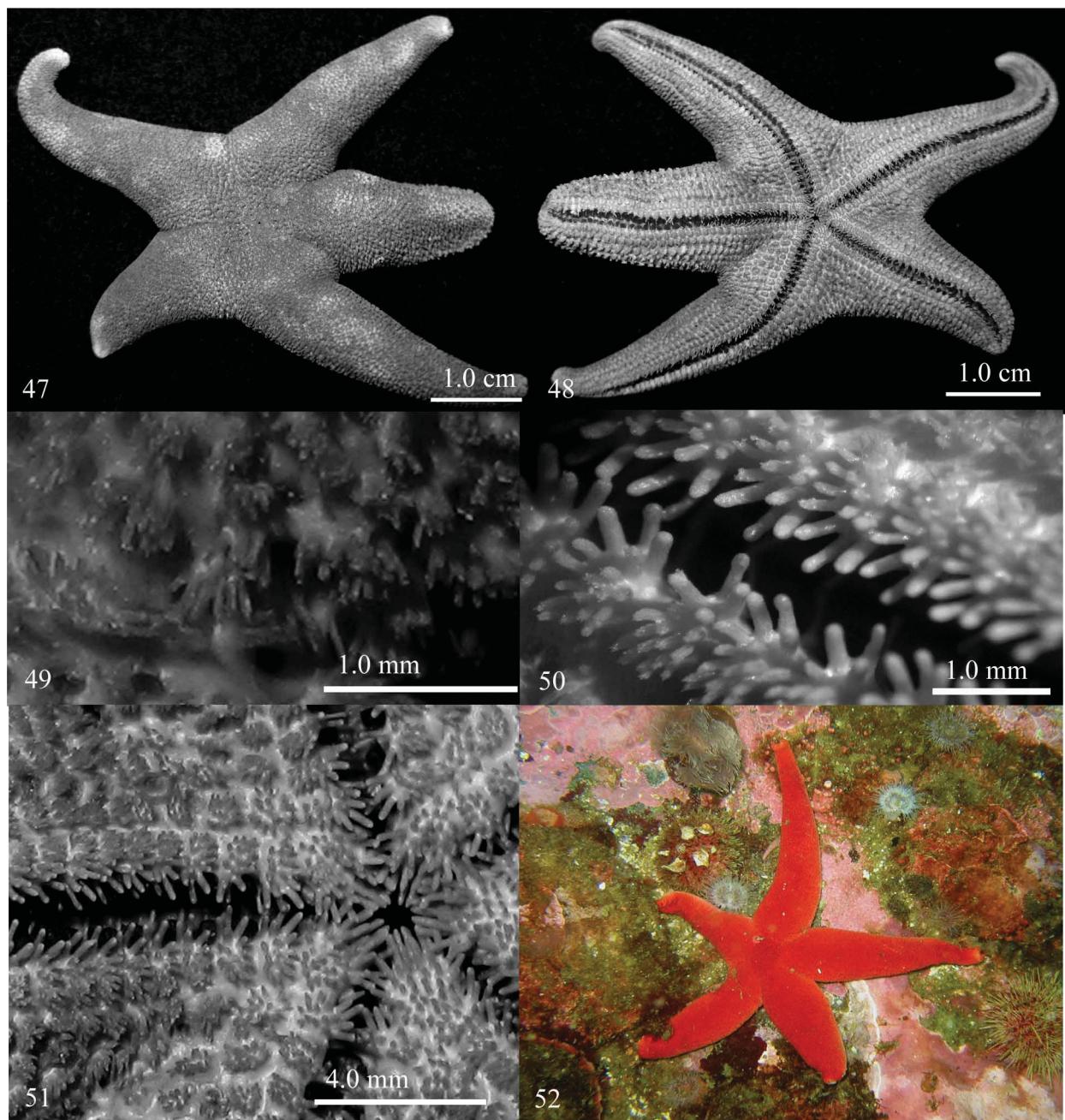
Henricia sanguinolenta eschrichtii (Müller & Troschel), Fisher, 1911: 276 (pars), *non Echinaster eschrichtii* Müller & Troschel, 1842: 25.

Type locality: Alaska, Aleutian Islands, Andreanof Islands, Adak Island, Kuluk Bay, Gannet Rocks (51°52.215 N, 176°36.383 E), 16 m. (AKALE07-A0014).

Type material: Holotype, LACM 2007-100.001 (leg. H. Chenelot, 12 July, 2007); Paratype, USNM 1125121 Alaska, Aleutian Islands, Rat Islands, Rat Island (51°49.288 N, 178°07.256 E), 14 m (leg. R.N. Clark, 1 July, 2007) (AKALE07-A0031).

Diagnosis: Small, inflated, R to 3.4 cm; disc large, rays relatively short, thick at base, tapering sharply to a slender tip; abactinal plates small, tightly spaces, bearing 6–18 thorny spinules; adambulacrals with 4–5 large, thick, blunt spines near furrow edge (arranged 1+2-3+2), followed by 10–16 much finer spines in 3 irregular rows. Oral plates with 5 thick marginal and 10–15 similar sub-marginal spines. Color in life uniformly red or yellow.

Description: Small, inflated, R to 3.4 cm (Holotype), r to 1.1 cm, R:r 3–4.3 (Figs 47 & 48); disc broad, inflated, rays short, thick at base, tapering sharply to slender tips. Abactinal plates small, forming a tight reticulation (Fig. 49); pseudopaxillae round to elliptical, bearing 11–32 thorn-tipped spinules; papular areas small, with 1 sometimes 2 papulae per area; madreporite small, located about half way between anus and disc margin, and bearing irregular sub-radial rows of spines. Supreromarginals 2 to 4 times as large as abactinal plates; intermarginal in 2 small, irregular rows, extending about 1/4 of R; inferomarginals about 1/3 larger than superomarginals, and bearing 23–26 spinules. Actinal inter-radial plates about 1/3 or less the size of inferomarginals, extending about 75% of R, a second, smaller series extends only to near the disc margin. Adambulacrals (Fig. 50) with 15–19 spines, a single fairly slender, blunt spine deep in furrow; 1 large thick, blunt spine at edge of furrow with 2 similar spines behind, followed by 2 similar, slightly shorter spines, behind which are 10–14 much shorter, more slender spines (about 1/2 as long) in 3 irregular rows. Oral plates (Fig. 51) with 5 fairly long, stout, blunt marginal spines and 10–16 similar, shorter sub-oral spines, grading shorter aborally. Color in life (Fig. 52) uniform, bright red-orange or yellow.



FIGURES 47–52. *Henricia gemma*, Holotype, LACM 2007-100.001. Fig. 47, Whole animal, Abactinal view. Bar = 1.0 cm. Fig. 48, Whole animal, actinal view. Bar = 1.0 cm. Fig. 49, Close-up, abactinal surface. Bar = 1.0 mm. Fig. 50, Adambulacral region. Bar = 1.0 mm. Fig. 51, Oral region. Bar = 4.0 mm. Fig. 52, Holotype, live, *in situ*. R = 5 cm.

Distribution: Alaska, Aleutian Islands, Andreanof and Rat Islands, 12–16 m. Although presently known only from the central Aleutians, because of its similarity to *Henricia tumida*, further investigation is needed to determine if *H. gemma* is endemic to this region or is more wide spread in the Aleutians.

Habitat: Subtidal boulders and bedrock, typically on substrate with encrusting coralline algae and sponges.

Etymology: Name is from the Latin, for jewel, in reference to the color of the live animals.

Remarks: *Henricia gemma* is superficially very similar to *H. tumida*, with which it shares the same habitat, but may be distinguished by 1) the sharply tapering rays, and 2) much more numerous adambulacral spines, 16–19 versus 6–9 in *H. tumida*. This species may be wide spread in the Aleutians, but is undoubtedly overlooked because of its similarity to *H. tumida*. It also bears some resemblance to *H. arctica* Verrill, 1914,

but differs in 1) longer rays which taper sharply to slender tips, those of *H. arctica* are very short and stubby; 2) more numerous abactinal spinelets, 11–32+ versus 10–15; 3) fewer adambulacral spines, 15–19 grading smaller distally, compared to "several rows of 5–8 spines" (20–32+ in 4 or 5 rows?).

***Henricia vermillion* sp. nov.**

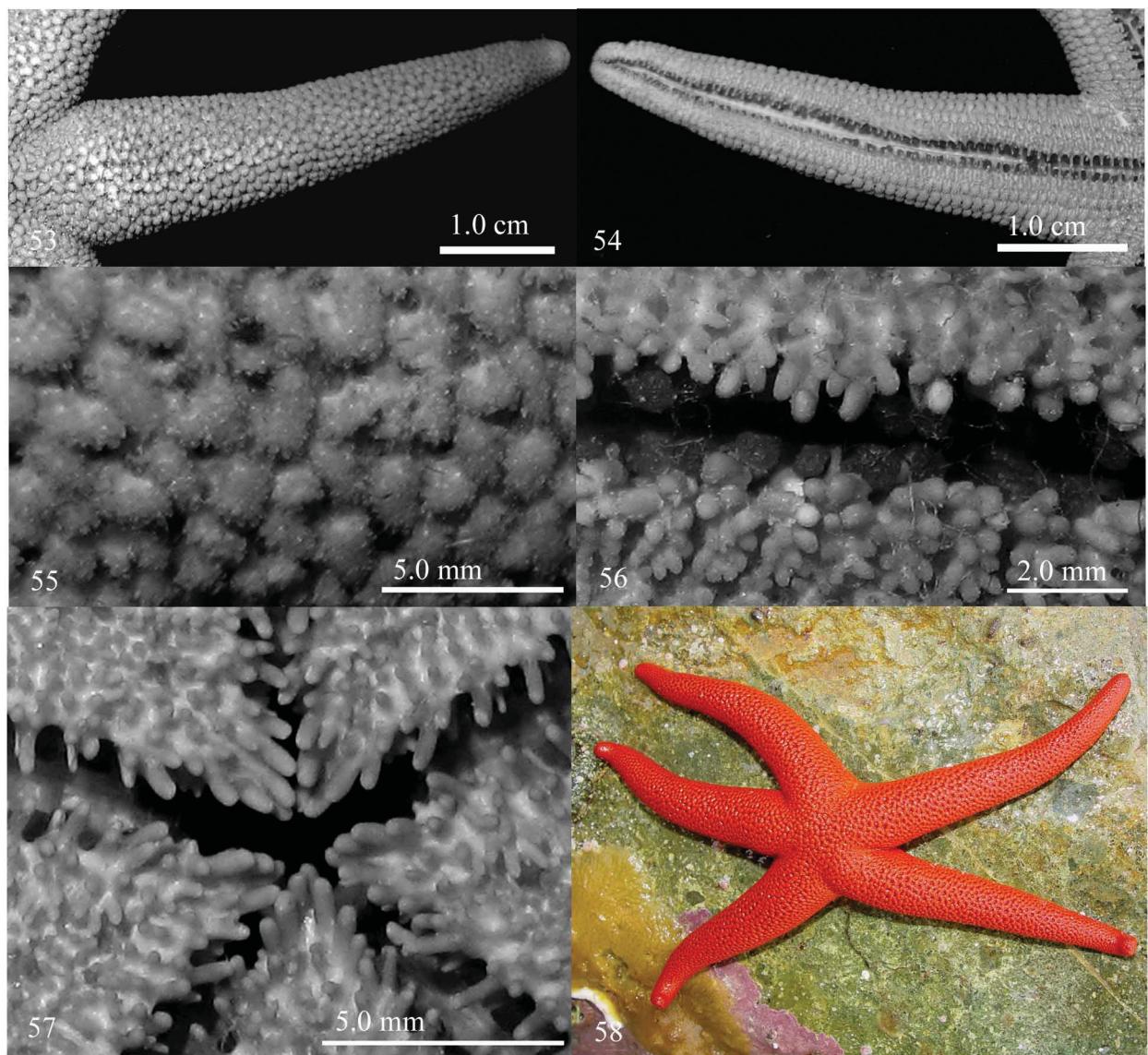
Figures 53–58

Henricia leviuscula (Stimpson) Fisher, 1911: 280, (pars), non *Linckia leviuscula* Stimpson, 1857.

Henricia leviuscula leviuscula (Stimpson) Lambert, 2000: 104 (pars), *Linckia leviuscula* Stimpson, 1857.

Type locality: Alaska, Aleutian Islands, Fox Islands, Unalaska Island, Sumner Bay (54°55' N, 166°36' W), intertidal.

Type material: Holotype, LACM 1993-211.001, 1 Paratype, LACM1993-211.002, 1 Paratype, USNM 1125120 (all types, leg. R.N. Clark, 18 June, 1993.)



FIGURES 53–57. *Henricia vermillion*, Holotype, LACM 1993-211.001. Fig. 53, Ray, abactinal view. Bar = 1.0 cm. Fig. 54, Ray, actinal view. Bar = 1.0 cm. Fig. 55, Close-up, abactinal surface. Bar = 5.0 mm. Fig. 56, Adambulacral region. Bar = 2.0 mm. Fig. 57, Oral region. Bar = 5.0 mm.

FIGURE 58. Live, *in situ*. Type locality, intertidal (image: R. Clark, 16 June, 2003).

Diagnosis: Moderately large, R to 10 cm; disc somewhat inflated, rays fairly broad at base, long, tapering to slender points; abactinal plates small oblong shaped, fairly close placed, bearing 38–50 (on larger plates) pointed spinules, bearing numerous thorns; adambulacrals with 7–9 very thick, blunt spines, largest one at furrow edge, 1–2 slightly smaller ones behind, followed by 2 rows of 3 shorter spines. Color in life bright vermillion or scarlet.

Description: Moderately large, R to 9.7 cm (Holotype R = 5.4 cm), r to 1.2 cm R:r 5.8–8.0 (Figs. 53 & 54); disc small somewhat inflated, rays long, broad at base, tapering to slender tip. Abactinal plates (Fig. 55) small, fairly close-set, bearing 38–55 (on larger plates) fairly stout, tightly packed, strongly pointed spinules, bearing numerous thorns; papular area about as large as abactinal plates, each with 3–5 papulae; madreporite small, round, bearing irregular, broken spiny ridges, located about 1/2 way between anus and disc margin. Superomarginals about two or more times as large as abactinals, and bearing 32–38 spinules; intermarginals irregular, extending just 20–25% of R; inferomarginals about 1/3 larger than superomarginals, and bearing 38–45 spinules; actinal inter-radials about 1/2 as large as inferomarginals, and bearing 21–18 spinules. Adambulacrals (Fig. 56) with normally 7–9 (rarely 10) spines, a single short, deep furrow spine, 1 rarely 2 large, thick, blunt spines at the furrow edge, 2 similar, slightly shorter spines behind, followed by 2 rows of 2–3 shorter spines. Oral plates (Fig. 57) with 3 or 4 fairly long, thick, blunt or somewhat pointed marginal spines, and 3–4 similar, slightly shorter sub-oral spines. Color in life (Fig. 58) uniformly red or orange-red.

Distribution: Type specimens are all from Unalaska Island, but it has been observed at Umnak, Akun and Avatanak Is., and possibly as far west as Attu Island, from the intertidal to depths of 16 m. Because of its similarity to other *Henricia leviuscula*-like forms, further investigation is needed to determine the distribution of *Henricia vermillion*.

Habitat: Intertidal and shallow subtidal, on cobbles and boulders encrusted with coralline red algae, and sponges. Frequently in kelp beds [*Eularia* (*Alaria*) *fistulosa* and *Nereocystis luetkeana*].

Etymology: The name is the "old French" term for red.

Remarks: *Henricia vermillion* is the "common blood star" of the eastern Aleutian Islands and has been confused with the more southern *H. leviuscula*, but differs from that species in 1) more robust, inflated body; 2) much fewer adambulacral spines, 7–10 in *H. vermillion*, 15–17 in *H. leviuscula*; and 3) sharply pointed spines of the abactinal plates. It differs from *H. uluudax* by 1) more inflated body; 2) differently shaped abactinal plates; 3) much larger, thicker, pseudopaxillar spinules, which are pointed and bear numerous thorns in the present species, compared to just 3 long thorns in *H. uluudax*; and 4) much fewer adambulacral spines, 7–10 opposed to 19–24.

Henricia elachys sp. nov.

Figures 59–62 & 64

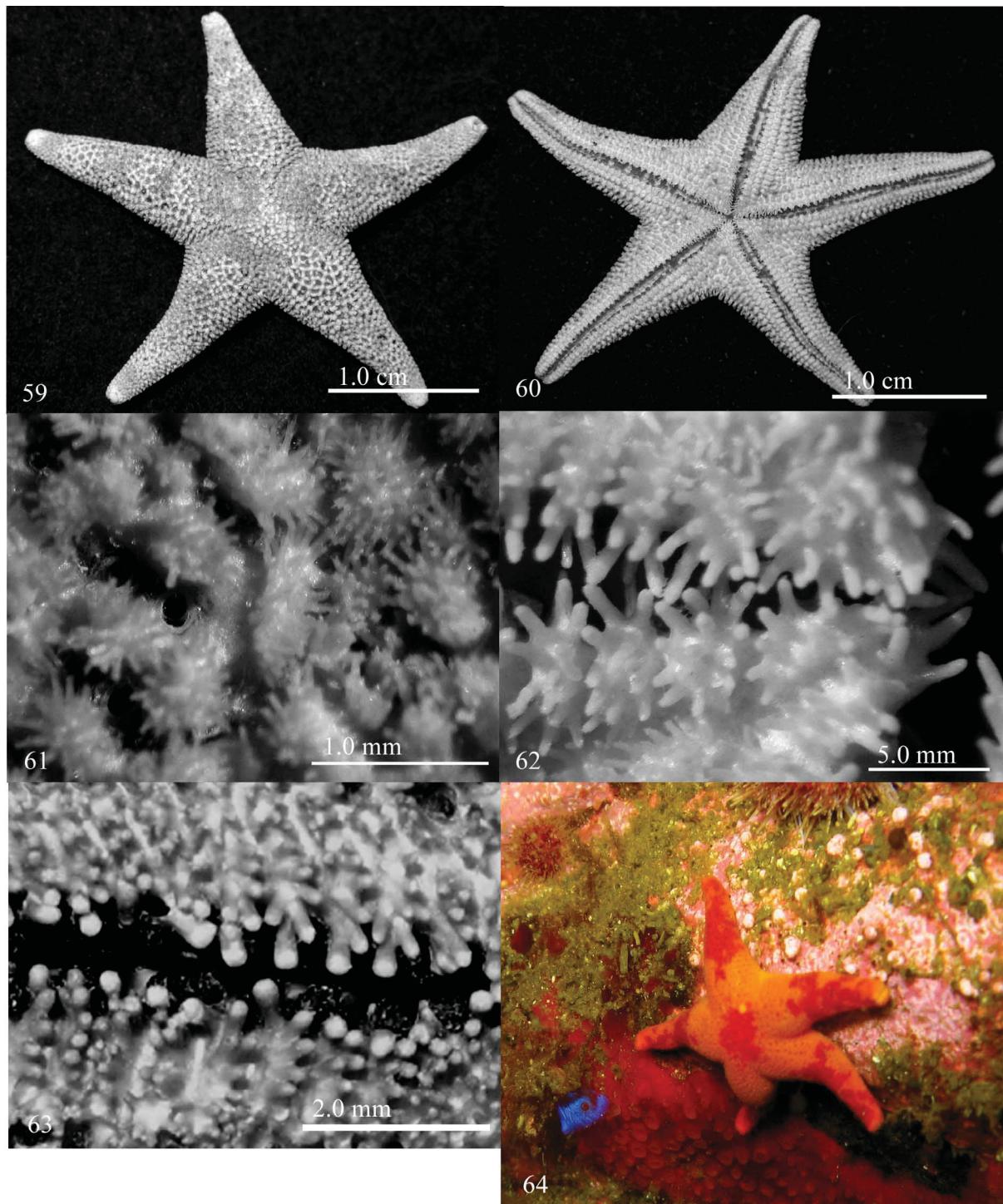
Type locality: Alaska, Aleutian Islands, Rat Islands, Rat Island (51°49.594 N, 178°27.184 E), 14 m. (AKALE07-A0031).

Type material: Holotype, LACM 2007-099.001; 1 Paratype, USNM 1125123 (leg. R.N. Clark, 1 July, 2007).

Diagnosis: Small moderately inflated, R to 2.3 cm, R:r 3–3.2; disc relatively broad, rays broad at base, tapering to slender tips; abactinal skeleton fine, open meshwork; pseudopaxillae round or oval, bearing 16–27 very slender spinules with 1–3 apical thorns. Actinal inter-radial series only about 75% of R. Adambulacrals with 10–16 rather slender spines, in 3 rows, 2 long spines at the furrow edge, followed by 2 lateral rows of 3–5, and a central row of 2–4. Color in life reddish, mottled with lighter colors.

Description: Small, moderately inflated, R to 2.3 cm (Holotype R = 2.1 cm), r to 0.7 cm, R:r 3–3.2 cm (Figs. 59 & 60); disc broad, rays relatively short, broad at base, tapering to slender tips. Abactinal plates small, round to oval, spaced about 1 diameter or so apart, giving a rather open reticulum; pseudopaxillae (Fig. 61) with 16–27 fairly long, even spinules, bearing 1–3 apical thorns; papular areas large, bearing 2–4 papulae each; madreporite small, round, spinose (spines often in broken ridges). Superomarginals twice or less the size

of abactinal plates, bearing 12–17 long spinules; intermarginals limited to a few irregular plates at base of rays; inferomarginals less than twice as large as superomarginals, bearing 21–25 slender spinules in 2–3 rows. Adambulacrals (Fig. 62) with 1 fairly long, bent spine deep in furrow, 10–16 fairly long, stout actinal spines in 2 lateral rows of 3–6, and a (usually) partial central row of 2–4, 1–2 at edge of furrow much longer than others. Oral plates (Fig. 62) with 5 thick, blunt or pointed marginal and 6–9 similar sub-oral spines. Color in life (Fig. 64) reddish, often with lighter mottlings on abactinal surface, actinal surface yellow-cream.



FIGURES 59–62. *Henricia elachys*, Holotype, LACM 2007-099.001. Fig. 59, Whole animal, abactinal view. Bar = 1.0 cm. Fig. 60, Whole animal, actinal view. Bar = 1.0 cm. Fig. 61, Close-up, abactinal surface. Bar = 1.0 mm. Fig. 62, Close-up, adambulacral/oral region. Bar = 5.0 mm.

FIGURE 63. *Henricia tumida*, Close-up, adambulacral region. Bar = 2.0 mm Rat Island, 7 m (R.N. Clark coll.)

FIGURE 64. *Henricia elachys*, live, *in situ*, Amchitka Island, 12 m (leg. R. N. Clark, 8 June, 2008).

Distribution: The three type specimens all were taken at Rat Island, mixed with the similar appearing *H. tumida*, but it is probably wide spread in the Aleutians.

Habitat: bedrock and boulders encrusted with coralline red algae, various sponges, hydroids and bryozoans.

Etymology: From the Latin, meaning small.

Remarks: This small species was taken mixed with the similar and very variable *H. tumida* (Figs. 63), from which it differs in 1) more open abactinal skeleton; 2) very slender abactinal spinules, those of *H. tumida* are very thick and blunt; 3) much more numerous (10–16) adambulacral spines, which occur in 3 rows in *H. elachys*, versus a single (often irregular or staggered) row of 4–8 in *H. tumida* (Fig. 63); and 4) smaller, more numerous papulae 2–4 per area versus usually 1, rarely 2, large papulae in *H. tumida*.

Henricia insignis sp. nov.

Figures 65–70

Henricia leviuscula multispina Fisher, 1911: 286 (pars).

Henricia leviuscula spiculifera (Clark) Verrill, 1914: 232 (pars), non *Cribrella spiculifera* H. L. Clark, 1901.

Type locality: Alaska, Aleutian Islands, Rat Islands, Kiska Island, Vega Bay (51°54.869 N, 177° 26.865 E), 14 m (AKALE07-0017).

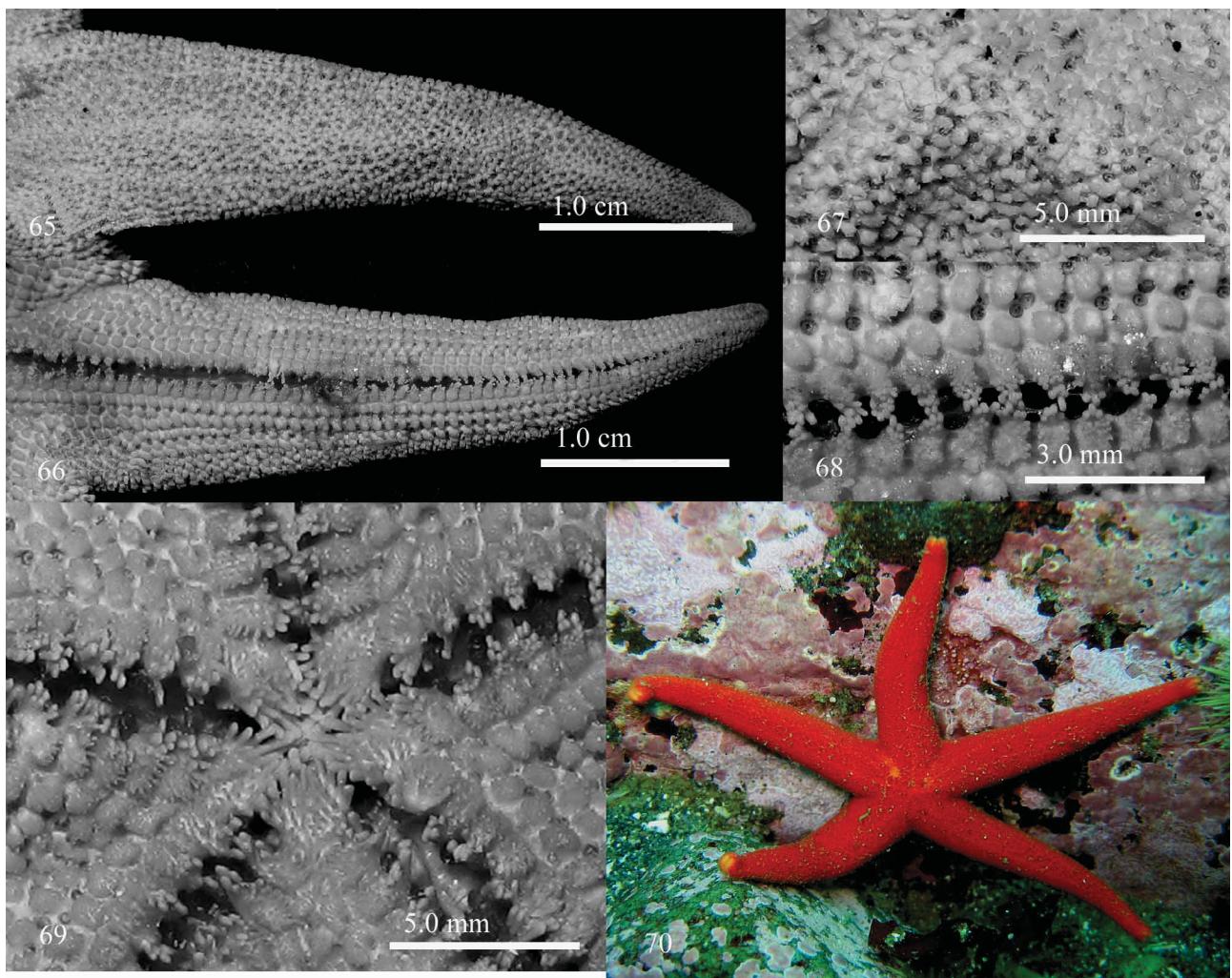
Type material: Holotype: LACM 2007-118.1 (leg. R. N. Clark, 29 June, 2007). 1 Paratype, LACM 1994-129.002, Alaska, Aleutian Islands, Andreanof Islands, S of Tanaga Island (51°37.50 N, 178°19.48 W) (leg. William C. Flerx, 5 July, 1994; trawled R/V *Pacific Knight*, 211 m) (95-941-111); 1 Paratype, USNM 1139296, Alaska, Aleutian Islands, Andreanof Islands, S of Kanaga Pass (51°47.08 N, 177°39.40 W) (leg. R. N. Clark, 4 July, 1994; trawled R/V *Vesteraalen*, 140 m) (NMFS 94-941-126); 1 RNC E51, Alaska, Aleutian Islands, Andreanof Islands, S of Kanaga Pass (51°47.08 N, 177°39.40 W) (leg. R. N. Clark, 4 July, 1994; trawled R/V *Vesteraalen*, 140 m) (NMFS 94-941-126).

Additional material: 1, RNC E66, Alaska, Aleutian Islands, Andreanof Islands, Petrel Bank (52°09.58 N, 179°42.62 E) (leg. R. N. Clark, 11 July, 1994; trawled R/V *Vesteraalen*, 94 m) (NMFS 94-941-153).

Photos: Aleutian Islands, Umak Island, Umak Bight (52°08.454 N, 175°58.282 W) (leg. Héloïse Chenelot, 14 July, 2007; scuba, 8 m) (AKALE07-0013); Aleutian Islands, Tanaga Island, Cape Amagalik (51°42.615 N, 178°06.201 W) (leg. Héloïse Chenelot, 7 July, 2007; scuba, 12 m) (AKALE07-DD0003); Aleutian Islands, Amchitka Island (leg. Héloïse Chenelot, 12 July, 2004; scuba 12 m).

Diagnosis: Relatively small star; R to 7 cm; disc small, rays relatively stout to moderately long R:r 4.5–5.8; rays with three rather faint, fine, longitudinal lines of close-set plates; skeleton thin, abactinal plates small, rounded, bearing 17–35 spinelets. Length inferomarginals about 1.5 to 2 times width. Adambulacrals, with 30–40+ spines. Color, uniformly crimson.

Description: Relatively small, fairly soft star Holotype (Figs. 65–69), R 6 cm, r 1.1 cm, R:r 5.4 R:r range 4.1–6.8; disc small, rays relatively stout to moderately long, tapering to slender, tips. Abactinal plates small, forming a fine-meshed reticulum, some plates very close set or fused into linear series, lacking papular areas between, forming three fine, lines on rays (Fig. 67; paxillae mostly round, bearing (usually) 17–35 (exceptionally up to nearly 50) spinelets tipped with 3–5 very sharp thorns; papular areas small, with 1–2 papulae; madreporite very small, circular, with irregular, radially spinose ridges, located closer to the anus than to the edge of the disc. Superomarginals about three times as large as adjacent actinolateral plates, and bearing about 35–40 thorn tipped spinelets; inferomarginal plates about twice (or less) as high as long, only slightly (+/- 1/3) larger than superomarginals, and bearing 43–56 thorn tipped spinelets; intermarginal plates irregular at base of rays, extending along rays in two series, about 60% and 40% of R, respectively. Adambulacrals (Fig. 68) with a single small spine deep in the furrow and 35–45 spines on the actinal surface, proximal 5–8 very large, thick, blunt, often somewhat compressed followed by 37–40+ much smaller, finer spines in a group, or 4–5 rows. Oral plates (Fig. 69) with 5 thick, blunt marginal and 20–25 suboral spines. Color (Fig. 70) in life uniformly crimson.



FIGURES 65–69. *Henricia insignis*, Holotype, LACM 2007-000.0. Fig. 65, Ray, abactinal view. Bar = 1.0 cm. Fig. 66, Ray, actinal view. Bar = 1.0 cm. Fig. 67, Close-up, abactinal surface. Bar = 5.0 mm. Fig. 68, Adambulacral region. Bar = 3.0 mm. Fig. 69, Oral region. Bar = 5.0 mm.

FIGURE 70. *Henricia insignis*, Live, in situ. Tanaga Island, Cape Amagalik (51°42.615 N, 178°06.201 W) (leg. Héloïse Chenelot, 7 July, 2007; scuba, 12 m) (AKALE07- DD0003). R = approx. 7 cm.

Distribution: *Henricia insignis* is found throughout the central Aleutians, from the Islands of Four Mountains, Chuginadak Island (52°48.289 N, 169°42.526 W) (AKALE06-0010) to Rat Islands, Kiska Island (51°54.869 N, 177°26.865°E) (AKALE07-0017) at depths of 0–210 m.

Habitat: Boulders and bedrock in shallow water (<20 m), covered with the thick encrusting coralline red algae *Clathromorphum*. In deeper waters, it is found on sand and cobble bottoms dominated by sponges and hydrocorals.

Etymology: The name is from the Latin and means remarkable, in reference to its brilliant red coloration.

Remarks: As with its congeners *Henricia lineata* and *H. uluudax*, *H. insignis* was thought by earlier workers (Fisher, 1911, Verrill, 1914) to be a variety or hybrid of *H. multispinosa* (see remarks under *H. lineata*). This species appears to be one of the varieties mentioned by Fisher (1911:288).

Henricia insignis may be distinguished from the similar *H. lineata* by 1) thinner skeleton, uniformly red coloration and more sharply tapering rays; 2) lack of distinctive light colored radial stripes on rays; 3) more open reticulation; 4) two rows of intermarginal plates, compared to one row in *H. lineata*; and 5) much more numerous adambulacral spines 35–45+ opposed to 14–17 in *H. lineata*. The two species are frequently found in the same habitat.

Henricia insignis superficially resembles *H. uluudax*, but differs in 1) much thinner skeleton; 2) smaller abactinal plates, bearing much fewer spinules, 17–35 compared to 37–60; and 3) much more numerous adambulacral spines 35–45+ opposed to 19–25 in *H. uluudax*.

From *H. multispina* it may be distinguished by 1) the relatively shorter rays (R:r 4.5 to 5.8 compared to 5.8–7.2 for *H. multispina*; 2) fewer abactinal spinules 17–35 opposed to 50–100+ in *H. multispina*; 3) intermarginal plates extending in two series, 40–60 % of R, in *H. multispina* the intermarginals absent, or restricted to a few irregular plates at base of rays; 4) shorter inferomarginal plates, length 1.5 to 2 times width, compared to 2.5 to 3 times in *H. multispina*; and 5) coloration, brilliant red in *H. insignis*, lavender to white in *H. multispina* (typically lavender on disc and upper portion of rays, fading to white on ray extremities). The adambulacral spine numbers are very similar, though *H. insignis* usually has a few more.

***Odontohenricia* Rowe and Albertson, 1988**

Five-rayed echinasterid sea stars with reticulated abactinal skeleton, plates raised centrally forming ridges which bear spinelets; marginal series distinguishable, inferomarginal plates pronounced; 1–3 furrow spine(s) in vertical series; large recurved (often hyaline) spine present at apex of each pair of oral plates, much greater in size than adjacent spines (modified from Row and Albertson, 1988)

Type species: *Odontohenricia endeavouri* Rowe and Albertson, 1988

***Odontohenricia aurantia* sp. nov.**

Figures 71–76

Henricia sanguinolenta (Müller), Fisher, 1910: 272, variety C (in part), non *Asterias sanguinolenta* O.F. Müller, 1776.

Type locality: Alaska, Aleutian Islands, Rat Islands, Rat Island (51°49.594 N, 178°27.184 E), 13 m. (AKALE07-A0031).

Type material: Holotype, LACM 2008-030.002 (Leg. R.N. Clark, 8 June, 2008; scuba 13 m); Paratype 1, USNM 1125116; Paratype 2, CASIZ 180537 (leg. S. Jewett & Shawn Harper, 1 July, 2007; scuba 14 m).

Additional material: 1, USNM (not located), Semisopochnoi Island (*Albatross* St. # 4778) Fisher, 1911: 275, plate 65.2 (upper specimen); plate 66.5.

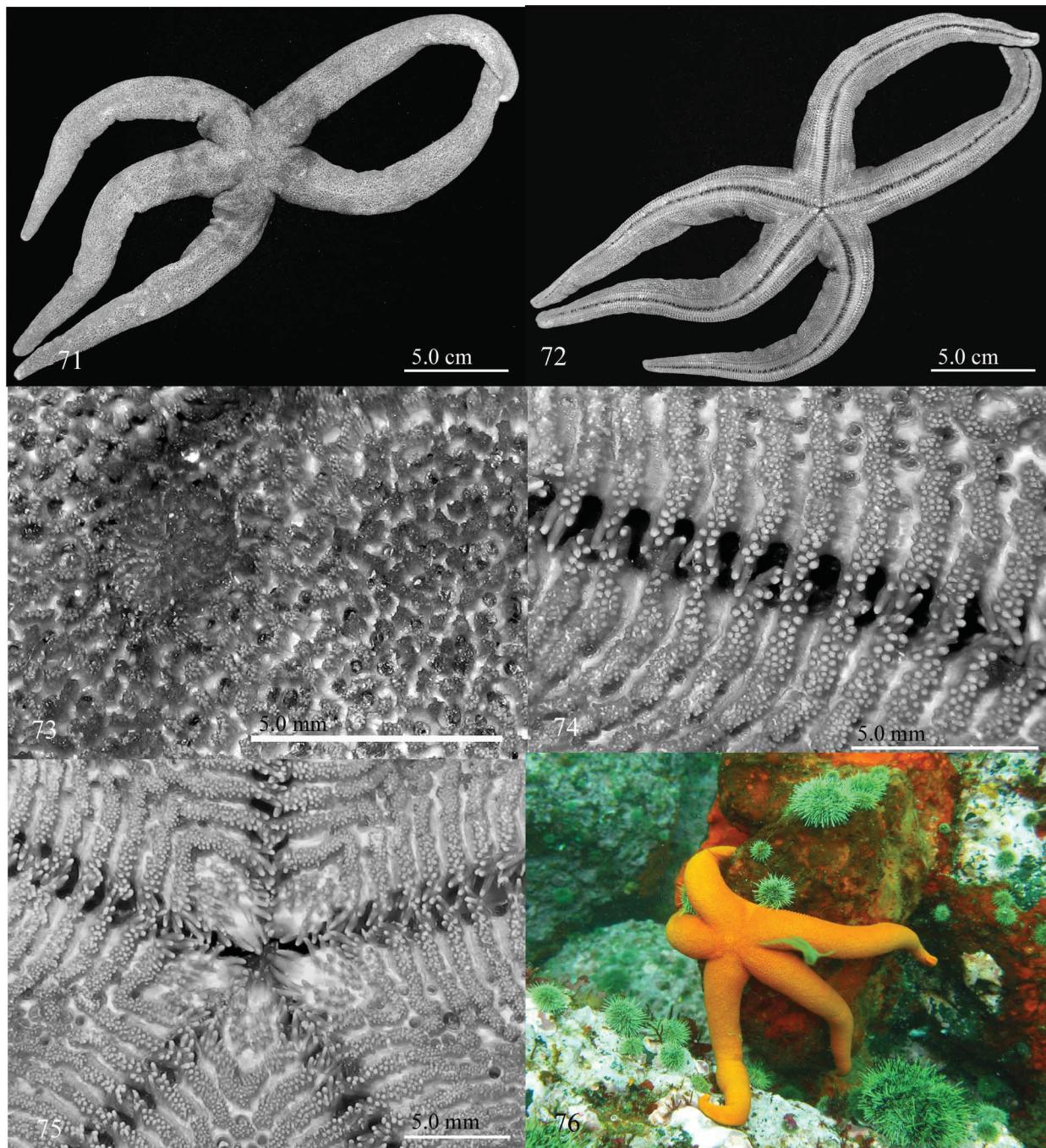
Diagnosis: Very large, slender-rayed, R to 17 cm; disc relatively small, rays very long, slender, tapering. Abactinal plates small, forming a rather close reticulation and crowned with numerous short (to 0.8 mm) spinelets; marginal plates forming two prominent series; oral plates with a very large apical spine, bordered on each side on each side by a similar smaller spine about 3/4 as large. Color in life bright orange.

Description: Very large, slender, R to 17 cm (Holotype 16.2 cm), r 2.7, R:r 6.2:1 (Figs. 71 & 72); disc relatively small, rays long, slender, tapering. Abactinal plates (Fig. 73) small, rather close set, forming a fine, relatively tight meshed skeleton, crowned with 10–20 pointed, thorn-tipped spinelets about 0.5 mm long; papular areas slightly larger than plates, with one to two papulae; madreporite small, equidistant between anus and disc margin, beset with radiating rows of spinelets. Superomarginals much larger than abactinals; intermarginal small, a single series extend just past the base of the rays, inferomarginals marginals somewhat larger than superomarginals, about twice as high as wide; actinal intermediates in three series, the first as large as superomarginals, and extending about 1/2 to 2/3 of R, second series smaller, and extending just past the base of the rays, and the third does not extend to the edge of the disc; adambulacrals (Fig. 74) with one or two spines deep in the furrow, one large, slender, blunt spine on the edge of the furrow, with two to five only slightly smaller, similar spines behind, followed by a grading series of 25–30 smaller spines, which may be in a random group, or in two to four linear series; adambulacral, actinal intermediate and marginal plates forming regular, transverse ridges, the furrows between bearing five to eight large, well spaced papulae. Oral plates (Fig. 75) with a single very large, curved spine at the apex of the paired plates, bounded on each side by a single slightly smaller spine, about 3/4 as large, and three to seven much smaller marginal spines, 13–24

suboral spines, and three to five short, pointed spines deep in the furrow, near the distal end of the edge of the plate. Color in life (Fig. 76), bright orange aborally and orally.

Distribution: Known from the type locality at Rat Island, east to Chuginadak Island (52°48.289 N, 169°42.526 W), at depths of 7–17 m. Endemic to the Aleutian Islands. *Odontohenricia aurantia* appears to be endemic to the central Aleutian region.

Habitat: Bedrock and boulders covered with the thick encrusting, coralline red algae *Clathromorphum nereostratum*, and large upright, red-orange sponges of an unknown identity, upon which it appears to feed, at temperatures of 4.4–4.6° C.



FIGURES 71–76. *Odontohenricia aurantia*, Holotype, LACM 2008-030.002. Fig. 71, Whole animal, abactinal view. Bar = 5.0 cm. Fig. 72, Whole animal, actinal view. Bar = 5.0 cm. Fig. 73, Close-up, abactinal surface. Bar = 5.0 mm. Fig. 74, Close-up, adambulacral region. Bar = 5.0 mm. Fig. 75, Close-up, oral region. Bar = 5.0 mm. Fig. 76, Live, *in situ* N side, Rat Island, 10 m, (AKALE07-A0031) (image: R. Clark, 8 June, 2008). R = 16 cm.

Etymology: From the Latin noun for orange, in reference to the bright orange coloration of living animals.

Remarks: Fisher (1911) apparently struggled with these animals, and finally took the view that the enormous henriciids from the Aleutians were varieties of *Henricia sanguinolenta* (O. F. Müller, 1776) and remarked that "The variations are legion and are bewildering" "A ventral view reminds one strongly of a very large (*Henricia*) *leviuscula* with compressed marginals, while an abactinal view suggests sometimes *sanguinolenta*, and sometimes *leviuscula* with unusually small plates". Fisher went on to discuss Gigantism and possible hybridization, finally remarking that " they act like hybrids", and "whatever the true explanation of these remarkable variations, it does not seem advisable at present to give them a name". It is obvious from Fisher's descriptions and illustrations that this is (at least in part) his " *H. sanguinolenta* variety C" (Fisher, 1911, plate 66 figs. 2–5) from Semisopochnoi Island (*Albatross* St. # 4778) (Fisher's material was examined by R.N. Clark in February, 1998, and confirm these findings). Other similar (but as yet undescribed) species were also included in Fisher's "variety C". Apparently he did not notice the remarkable oral plate pairs united by an oversized apical tooth.

***Odontohenricia ahearnae* sp. nov.**

Figures 77–82

Type locality: Alaska, Aleutian Islands, Islands of Four Mountains, Carlisle Island, east side (52°53.937 N, 169°59.730 W), 7 m. (AKALE06-0011).

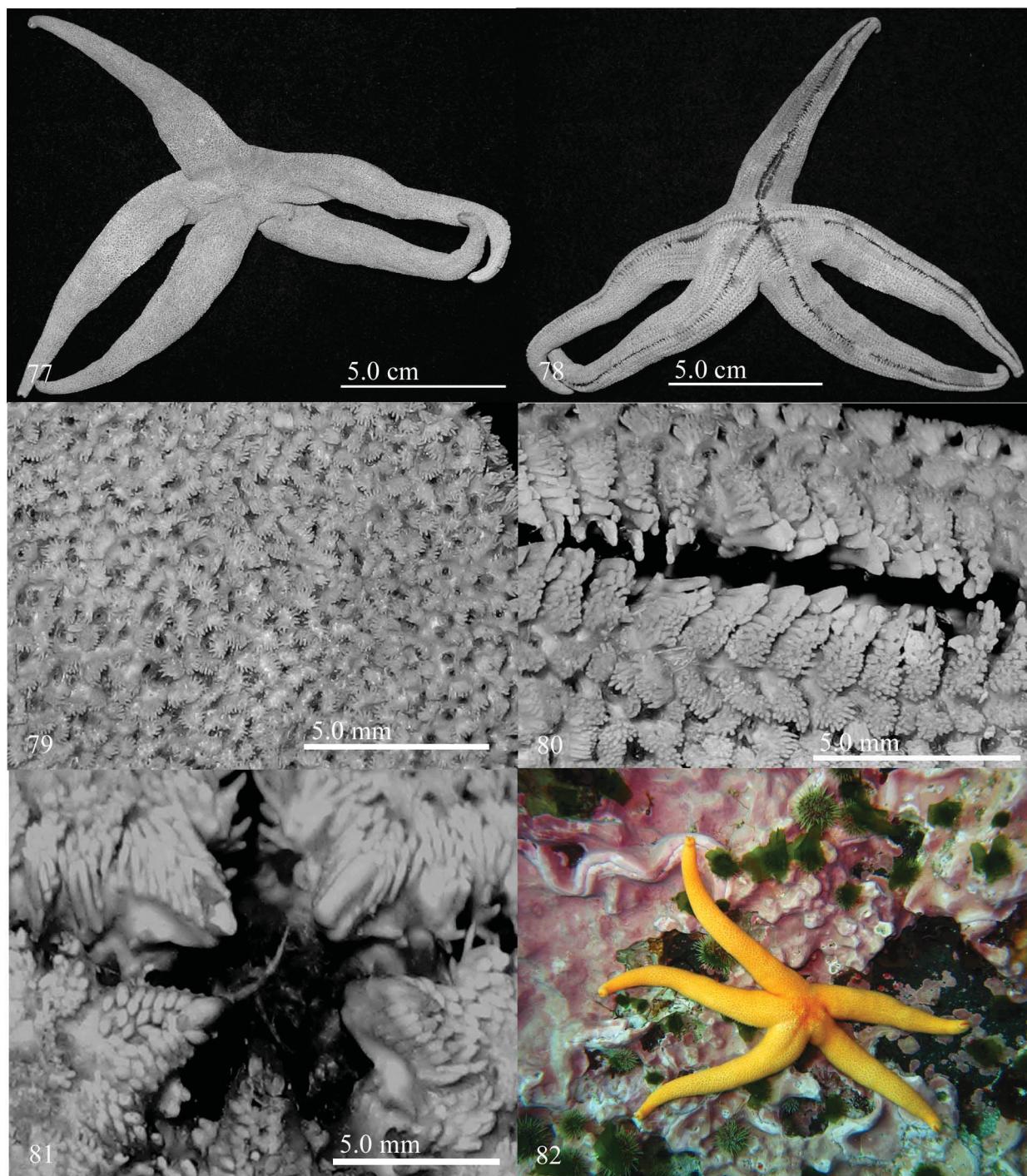
Type material: Holotype, USNM 1125114 (leg. R.N. Clark, 15 July, 2006; scuba 7 m); Paratype, LACM 2006-141.001 (from type locality); Paratype, LACM 1997-217.001 Alaska, Aleutian Islands, Rat Islands, E of Kiska Island (51°46.55 N, 178°10.81 E; NMFS 23-199901-133) (leg. R.N. Clark, 14 July, 1997; trawled R/V *Dominator*, 108 m); Paratype, CASIZ 180534 Alaska, Aleutian Islands, Rat Islands, E of Kiska Island (51°46.55 N, 178°10.81 E; NMFS 23-199901-133) (leg. R.N. Clark, 14 July, 1997; trawled R/V *Dominator*, 108 m); 1 Paratype, UAM 8131 Alaska, Aleutian Islands, Andreanof Islands, SE of Amlia Island (Seguam Pass) (51°55.72 N, 172°53.58 E) (leg. R.N. Clark, 5 June, 1997; trawled R/V *Dominator*, 214 m).

Diagnosis: Large slender to moderately inflated, R to 13 cm; disc relatively small, rays moderately long, tapering to slender tips. Abactinal plates forming a relatively tight reticulation; marginal plates widely separated at base of rays; oral plates with large, recurved, hyaline apical tooth, with six to eight marginal teeth on each side; color light orange with large red-orange or purple blotch on center of disc.

Description: Large slender to moderately inflated stars, R to 13 cm (Holotype R = 12.1), r to 2 cm, R:r 6.5:1 (Figs. 77 & 78); disc small, rays long, slender, often somewhat inflated at base, tapering to slender tips. Abactinal plates (Fig. 79) small, round to oblong, up to three times as long as wide, crowned with 25–50+ short (to 0.2 mm), thorn-tipped spinelets; madreporite small, spinose, located equidistant between anus and disc margin. Marginal widely separated at base of rays; superomarginals approximately two or three times as large as aboral plates, crescent-shaped, set in a distinct, oblique row; intermarginal plates in two series, plates of the first very small (about 1/4 to 1/3 the size of the superomarginals), inconsistant series, extending a little past the base of the rays and often alternating with the second series, the second series of plates much larger, about 2/3 as large as the superomarginals and extending about 70 to 80% of R; inferomarginals somewhat larger than superomarginals; actinal intermediate plates arrayed in three series, plates of the first series, about as large as inferomarginals (and often difficult to distinguish from the adambulacrals), extending about 70–80% of R, second and third series much smaller, and extending just past the base of the rays. Adambulacrals (Fig. 80) with single spine deep in furrow, three to four large, compressed, spatulate actinal spines, the largest one at the furrow edge, followed by two or three similar, but slightly smaller spines, behind which are series of 12–16 much smaller, grading, pointed spinelets. Oral plates (Fig. 81) rather small, with a very large, robust, recurved, hyaline-tipped spine or tooth at the apex of the paired plates, six to eight much smaller marginal spines, and six to eight similar, suboral spines in one or two series or in a group, two robust, blunt spines deep in the furrow, near the base of the plate. Color in life (Fig. 82), aborally, yellow, pale pinkish or tan, with a large orange, red or purplish blotch on the disc.

Distribution: Alaska, Aleutian Islands, Islands of the Four Mountains, Carlisle Island (52°53.937 N, 169°59.730 W) to Rat Islands, E of Kiska Island (51°46.55 N, 178°10.81 E), at depths of 7–442 m. *Odontohenricia ahearnae* appears to be endemic to the Aleutian province.

Habitat: Sponge beds on bedrock or boulder/cobble bottoms with water temperatures of 4.3–5°C. Uncommon in shallow kelp beds (<20 m).



FIGURES 77–82. *Odontohenricia ahearnae*, Holotype, USNM 1125114. Fig. 77, Whole animal, abactinal view. Bar = 5.0 cm. Fig. 78, Whole animal, actinal view. Bar = 5.0 cm. Fig. 79, Close-up, abactinal surface. Bar = 5.0 mm. Fig. 80, Close-up, adambulacral region. Bar = 5.0 mm. Fig. 81, Close-up, oral region. Bar = 5.0 mm. Fig. 82, Live, *in situ*, Carlisle Island (52°53.973 N, 169°59.730 W), 11 m (AKALE06-0011) (image: R. Clark, 15 July, 2006). R = 13 cm.

Etymology: It is with great pleasure that we name this species after the late Cynthia Ahearn, former echinoderm collections manager at the U. S. National Museum for her great enthusiasm and many contributions to the study of echinoderms.

Remarks: *Odontohenricia ahearnae* is a common shelf species, and is frequently taken in trawls.

***Odontohenricia violacea* sp. nov.**

Figures 83–88

Type locality: Alaska, Aleutian Islands, Andreanof Islands, S of Amatignak Island (51°11.935 N, 179°05.87 E), 95 m.

Type material: Holotype, LACM 2004-279.001 (leg. R.N. Clark, 4 July, 2004; trawled R/V *Sea Storm*, 95 m) (NMFS 143-0401-110).

Diagnosis: Large, slender stars; disc small, rays very long, slender; abactinal surface covered with a thick, cuticle-like epidermal layer; aboral plates small, close-set, bearing 6–12 pointed spinelets; Color violet abactinally, pale yellow-cream actinally.

Description: Large, long, slender rays, R to 21.3 cm, r 2 cm, R:r 10.65:1 (Figs. 83 & 84); disc small, rays very long, slender, gradually tapering. Abactinal surface (Fig. 85) covered with a thick, purple, almost cuticle-like epidermal layer which completely obscures the abactinal plates. Abactinal plates small, round or oblong, crowned with five to ten short (0.5 mm), bluntly pointed spinelets; abactinal plates close set, forming a very fine reticulation with small papular areas, each with a single papula; madreporite small, about 3 mm in diameter, with irregular radiating ridges. Superomarginals about twice as long as wide, bearing three or four rows of 8–10, stout, sharp, thorn-like spines 0.4 mm in length; inferomarginals three times as long as wide, bearing three or four rows of 11–13 spines, similar to those of the superomarginals; intermarginals small, about the same size as abactinal plates, in a single series extending 20% of R; two series of actinal intermediate plates, the first about half as large as inferomarginals, bearing three or four rows of six to eight sharp, thorn-like spines, about 0.4 mm long, and extending about 1/2 of R, where they become very irregular and mostly absent, to about 3/4 of R; second row much smaller, bearing five to ten similar spines and extending irregularly to about 20% of R. Adambulacrals (Fig. 86) with a single short, deep furrow spinelet, one or two large flesh covered spines at the furrow edge, with two similar, slightly smaller spines behind, followed by mostly three series of seven to ten, smaller, sharper, distally grading spines; adambulacral, actinal intermediate and marginal plates forming regular, transverse ridges, the furrows between bearing four or five large, well spaced papulae. Oral plates (Fig. 87) with a large, slender, sharply pointed apical spine, beside which on each plate is a similar, spine about 3/4 as large as the apical spine, five or six sharply pointed marginal spines, a group of eight to ten sharp, suboral spines, and four or five short, very stout, blunt teeth deep in the furrow. Color in life (Fig. 88), uniformly violet aborally, pale yellowish-cream orally. Color remains even after years in ethanol;

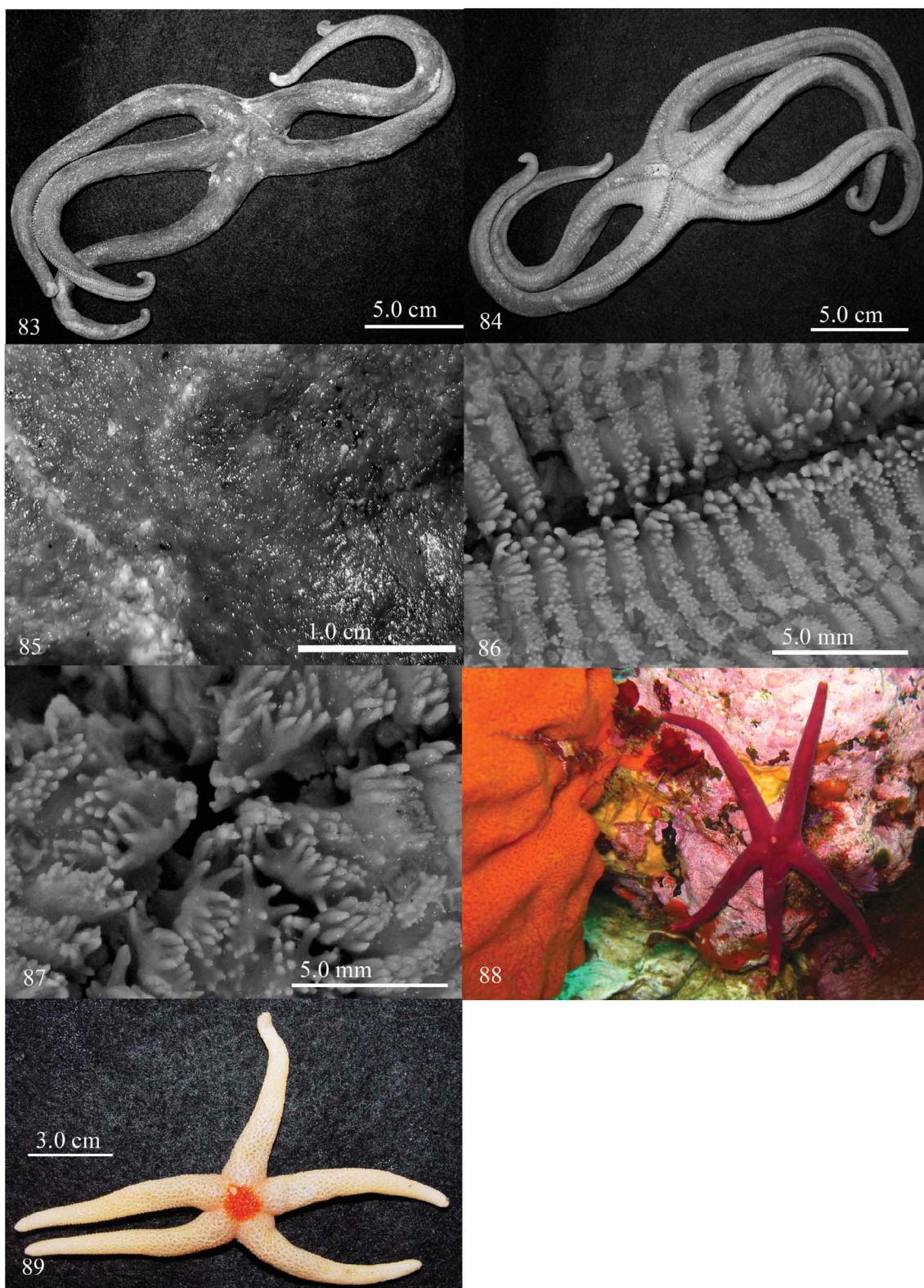
Distribution: Alaska, Aleutian Islands, Rat and Andreanof Islands. Only known from two locations, the type locality, south of Amatignak Island (51°11.935 N, 179°05.87 E) and the north side of Rat Island (51°49.594 N, 178°16.676 E) (leg. Stephen Jewett, 1 July, 2007, scuba 14 m; AKALE07-A0031; photo only) at depths of 14–95 m. A rare species, apparently endemic to the central Aleutian Islands. Further investigation is needed to precisely map out its distribution.

Habitat: Subtidal bedrock and boulder bottoms with abundant sponges, and bottom temperatures of 5–5.4°C.

Etymology: Named for the beautiful violet aboral coloration.

Remarks: This unusual star is unique among *Odontohenricia* because of its very slender rays, very tight meshed aboral plates and strange, dermal layer on the aboral surface.

The three presently described species of *Odontohenricia* are the first of this genus described from the Aleutian Islands, and are part of a complex of at least six species in the region (R.N. Clark, *unpub.*), some of which grow to considerable size, R to 23 cm.



FIGURES 83–87. *Odontohenricia violacea*, Holotype, LACM 2004-279.001. Fig. 83, Whole animal, abactinal view. Bar = 5.0 cm. Fig. 84, Whole animal, actinal view. Bar = 5.0 cm. Fig. 85, Close-up, abactinal surface showing thick cuticle-like dermal layer that obscures the abactinal plates. Bar = 1.0 cm. Fig. 86, Close-up, adambulacral region. Bar = 5.0 mm. Fig. 87, Close-up, oral region. Bar = 5.0 mm.

FIGURE 88. *Odontohenricia violacea*, live, *in situ*, N side, Rat Island (51°49.594 N, 178°16.676 E), 14 m (AKALE07-A0031) (image: S. Jewett, 1 July, 2007). R = approximately 8 cm.

FIGURE 89. *Odontohenricia fisheri*, live animal, Gulf of Alaska, SW of Yakutat (59°15.018 N, 140°52.892 W) (NMFS 143-0301-261) trawled R/V *Sea Storm*, 158 m (leg. R. Clark, 26 July, 2003). Bar = 3.0 cm

One other species of *Odontohenricia* is known from Alaskan waters, *Odontohenricia fisheri* Rowe and Albertson, 1988 (Fig. 89), previously known only from the type specimen from off Washington State (48°33' N, 124°53' W), at 108 m. R.N. Clark has collected this species from several localities in the Gulf of Alaska, at depths of 105–210 m on black (volcanic) sand and pebbles, rich with sponges. The northwestern most site SW of the Shumagin Islands (54°25.542 N, 161°2.886 W) (leg. R.N. Clark, 27 May, 1999; trawled R/V *Dominator*, 105 m on black sand; NMFS 23-199901-48; LACM 1999-182.001), eastern end of the Aleutian chain. The range herein extended north and west approximately 2400 km.

Discussion

The nearshore subtidal community of the Aleutian Archipelago is understudied in comparison to other nearshore regions in North America. The remoteness of the region and adverse weather, coupled with the rocky substratum that limits sampling with standard remote techniques such as trawls or grabs, has resulted in few shallow collections there. The thirteen new species described here attest to just how poorly studied the region is.

Since 1994, the asteroid fauna of the Aleutian Islands has been the subject of intensive study by R.N. Clark. The fauna is very large and diverse, and more than 110 species (including many new species) have been recovered (by R.N. Clark) from intertidal to depths of about 500 m, many of which are apparently endemic, based on extensive surveys in the adjacent Gulf of Alaska, and Bering Sea (by R.N. Clark), as well as a literature review of Russian work off Kamchatka and the Kurile and Commander Islands (D'yakonov, 1950, 1958). The family Echinasteridae with > 20 species in three genera is a substantial element of that fauna.

A breakdown of the 23 known species of the family Echinasteridae in the shallow (<20 m) waters of the Aleutian Islands in relation to which faunal provinces they represent is as follows. It is not surprising to find that of the 23 species included in this report 18, *Aleutihenricia federi*, *Odontohenricia aurantia*, *O. ahearnae*, *O. violacea*, *Henricia aspera*, *H. asthenactis*, *H. tumida*, *H. longispina*, *H. multisepia*, *H. lineata*, *H. iodinea*, *H. rhytisma*, *H. echinata*, *H. uluudax*, *H. gemma*, *H. vermillion*, *H. insignis*, and *H. elachys*, are members of the Aleutian (amphi-Pacific) Province, and six of these species, *Henricia aspera*, *H. asthenactis*, *H. tumida*, *H. longispina*, *H. multisepia*, *H. lineata*, have ranges that extend across the north Pacific, from North America to Asia. Eleven species, *Aleutihenricia federi*, *Odontohenricia aurantia*, *O. ahearnae*, *O. violacea*, *H. iodinea*, *H. rhytisma*, *H. echinata*, *H. uluudax*, *H. gemma*, *H. insignis*, and *H. elachys* appear to be endemic to the Aleutian Islands, and six of these, *O. aurantia*, *O. violacea*, *H. echinata*, *H. gemma*, *H. insignis*, and *H. elachys* are apparently restricted to the central Aleutians and may form part of a distinct faunistic pocket or subprovince in that region. The Arctic fauna is represented by two species, *H. sanguinolenta*, and *H. oculata*. *Henricia oculata* was recently identified from material collected at Akun Island (leg. R.N. Clark, 12 June, 2008; scuba, 10 m) (added in review). It is perhaps not surprising to find this Arctic species in this region, since a finger of Arctic fauna appears to extend through Unimak Pass into the region of the Shumagin Islands, along the south side of the Alaska Peninsula, and several Arctic invertebrates (and some fish) have been found in this area (R.N. Clark, *pers. observ.*). The Oregonian Province appears to be represented only by *Odontohenricia fisheri*, although additional species may be expected. The Kurile Province is at present represented by two species, *A. beringiana*, and *A. derugani*. However, it is expected that further investigation in the Near Islands, will reveal more Asian species, as several other Asian asteroids are already recorded from these islands. In addition to the species recorded in this report, several additional species of *Henricia* and *Odontohenricia* (mostly undescribed) are known from deeper (50–500 m) waters in the Aleutians and are the subject of another report (R.N. Clark, *in prep.*).

The great radiation of *Henricia*-like asteroids in the North Pacific may be due, at least in part to the development of a very large and diverse sponge fauna, including more than 200 species of demosponges (Stone 2006; Heifetz *et al.* 2005). Echinasterids are generally sponge specialists, and some species are capable of suspension feeding and/or predation on sponges. Evidence suggests they capture food by tapping into the

feeding currents of the sponge. Anderson (1960) presented strong evidence pointing to *Henricia* spp. as ciliary feeders. Later, Rasmussen (1965) corroborated this for *Henricia sanguinolenta* (O.F. Müller, 1776). The *Henricia* spp. studied apparently trap bacteria and detritus in streams of mucus that are swept to the mouth by ciliary currents (Rasmussen 1965). Many species of echinasterids were observed in the Aleutian Islands on a variety of encrusting sponges, as well as coralline algae and bryozoans, in most cases these encrusting forms did not appear to be harmed. If echinasterids do take advantage of the currents created by its host, they may be regarded as "energy commensals" (Anderson 1966). Other known echinasterid - sponge associations include: *H. leviuscula leviuscula* (Stimpson, 1857) on the encrusting sponges *Sigmadocia* sp. and *Isodictya quatsinoensis*, *H. sanguinolenta* on *Mycale*, *Ficulina* and *Hymeniacidon* spp. (Lambert 2000), *H. asthenactis* Fisher, 1910 on hexactinellid sponges, *H. longispina aleutica* Fisher, 1911 on unknown demospongia and the *H. tumida* Verrill, 1909 on various encrusting forms (R.N. Clark, *pers. observ.*). However, except in the case of *H. tumida* complex, it was not determined if these sea stars actually fed on the sponges. Regarding echinasterids as predators, *H. leviuscula* everts the cardiac part of its stomach onto encrusting sponges and bryozoans, as well as the sponge *Halicondria panicea* and digests them (Mauzey *et al.* 1968; O'Clair & O'Clair 1998). *Henricia sanguinolenta* has also been reported to prey on sponges (Vasserot 1962). The best account of predation on sponges is for *H. sanguinolenta* off Massachusetts, USA (Sheild & Witman 1993). This sea star digested the soft tissue of *Isodictya palmata* and *I. deichmannae*, leaving distinct, non-pigmented lesions.

Although we can only speculate, it seems logical to assume that this specialization on sponges has given rise to the highly modified oral spines in *Odontohenricia*. The large apical oral spines or teeth may be more efficient at feeding on certain types of sponges, or perhaps it has developed for feeding on harder prey, such as coralline algae and bryozoans, which are also abundant in the region, and often show signs of predation in areas where these stars have been removed.

Key to the family Echinasteridae in the shallow (<20 m) waters of the Aleutian Islands.

| | | |
|-----|--|---------------------------|
| 1a | Marginal plates obvious and arranged in distinct linear series | 2 |
| 1b | Marginal plates absent or rudimentary | <i>Aleutihenricia</i> (3) |
| 2a | Paired oral plates united at apices by a single much enlarged spine or tooth..... | <i>Odontohenricia</i> (5) |
| 2b | Paired oral plates not united at apices by an enlarged spine or tooth | <i>Henricia</i> (8) |
| 3a | Abactinal plates bearing 2–4 (rarely 5) spines; adambulacrals with 7–13 spines; color in life solid white | <i>A. derjugini</i> |
| 3b | Abactinal plates typically with 5 or more spines; number of adambulacral spines variable; color in life not white | 4 |
| 4a | Abactinal plates bearing 5–9 spines; adambulacrals with 7 or 8 coarse spines; color in life usually nearly solid reddish on abactinal surface | <i>A. beringiana</i> |
| 4b | Abactinal plates bearing 8–15 spines; adambulacrals with 9–13 spines; color in life mottled with yellow-orange and maroon | <i>A. federi</i> |
| 5a | Apical oral tooth very stout, robust, often hyaline; much larger than marginal teeth | 6 |
| 5b | Apical oral tooth rather long and slender, adjacent sub-apical teeth about 3/4 as long, marginal teeth shorter..... | 7 |
| 6a | Abactinal skeleton rather coarse, plates forming an irregular, open reticulum; R rarely exceeding 8.5 cm..... | <i>O. fisheri</i> |
| 6b | Abactinal skeleton compact, plates small, closely spaced; R frequently exceeding 12 cm | <i>O. ahearnae</i> |
| 7a | Abactinal surface very smooth appearing; covered by thick dermal layer; rays very long and slender; oral plates with 13–16 marginal and sub-oral spines..... | <i>O. violacea</i> |
| 7b | Abactinal surface not smooth appearing or covered with thick dermal layer; rays long and, slender; oral plates with 16–31 marginal and sub-oral spines..... | <i>O. aurantia</i> |
| 8a | Superomarginal plates inconspicuous; inferomarginals about 3times as large as superomarginals; adambulacrals with 8–15 spines, 1+2–4+6–11, first 3–5 considerably longer than others | <i>H. sanguinolenta</i> |
| 8b | Marginal and actinal inter-radial series of plates conspicuous | 9 |
| 9a | Abactinal skeleton very open, papular areas as large or larger than plates or plate ridges | 10 |
| 9b | Abactinal skeleton tight, papular areas smaller than plates or plate ridges | 16 |
| 10a | Abactinal plates bearing groups of 16–27 very slender spinelets with 1–3 apical thorns; adambulacrals with 10–16 slender spines in 3 rows | <i>H. elachys</i> |
| 10b | Abactinal plates forming spinose ridges | 11 |

| | | |
|-----|--|-----------------------|
| 11a | Abactinal spines very long (1.25–2 mm), slender, sharply pointed; arranged in tufts of 1–5; adambulacrals with single (often staggered) row of 4–8 slender, sharply pointed or spatulate spines..... | <i>H. longispina</i> |
| 11b | Abactinal spines less than 1 mm in length, not arranged in tufts | 12 |
| 12a | Abactinal skeleton composed of narrow ridges, bearing a single row of spines | 13 |
| 12b | Abactinal skeleton composed of broad ridges, bearing 2 or more rows of spines | 14 |
| 13a | Abactinal ridges bearing 4–7 relatively long, thick, sharp spines, encased in thick membrane; adambulacrals with single row of 3–5 grading, stout, blunt spines | <i>H. asthenactis</i> |
| 13b | Abactinal ridges bearing 3–6 short, thick, well spaced thorns; adambulacrals with a single staggered row of 4–6, webbed spines | <i>H. aspera</i> |
| 14a | Abactinal ridges bearing 5–11 short, thick, bunt spines, in 2 irregular rows; adambulacrals with 9–11 spines, 3 longest nearest furrow | <i>H. echinata</i> |
| 14b | Abactinal ridges bearing 15 or more spines in 2–5 rows | 15 |
| 15a | Abactinal ridges with 15–20 short thick thorns in a group or 2–4 irregular rows; adambulacrals with 4–6 (rarely to 8) spines in a single staggered row | <i>H. oculata</i> |
| 15b | Abactinal ridges with 25–30+ short, thick, thorns in a group, or in 3–5 irregular rows; adambulacrals with 8–10 thick, blunt spines in 2 staggered rows | <i>H. rhytisma</i> |
| 16a | Abactinal surface rough, plates often forming irregular vermiculiform ridges; superomarginals larger, and of higher relief than abactinals, and curving notably upwards, at base of rays; adambulacrals with 12–15 spines, 1+2+9–12 in group or 3 rows | <i>H. iodinea</i> |
| 16b | Abactinal surface not rough; superomarginals not prominent and of higher relief than abactinal plates | 17 |
| 17a | Adambulacrals with fewer than 12 spines | 18 |
| 17b | Adambulacrals with more than 12 spines | 19 |
| 18a | Adambulacrals with 4–9 short, thick often distally swollen spines, arranged in a single, or sometimes a staggered double row; prominent row of large singular papulae between actinal inter-radial and inferomarginal plate series; R rarely exceeding 4 cm, R:r 2–5; color in life, highly variable | <i>H. tumida</i> |
| 18b | Adambulacrals with 7–10 cylindrical, spines arranged 1+ 2 rows of 3–5; R often exceeding 7 cm, R:r 5.8–8; color in life, red or orange-red | <i>H. vermillion</i> |
| 19a | Disc broad, rays short, broad at base, tapering to slender tips, R:3–3.4; abactinal plates with 11–32 spinules; adambulacrals with 15–19 spines, 1 + 2 + 2 + 10–14 in 3 rows | <i>H. gemma</i> |
| 19b | Disc small, rays long, slender; R:r 4.5–7 | 20 |
| 20a | Adambulacrals with 30–45+ spines | 21 |
| 20b | Adambulacrals with fewer than 25 spines | 22 |
| 21a | Abactinal and actinal surfaces velvet-like in appearance, abactinal plates with 50–90+ very fine, divergent spinules; intermarginals lacking | <i>H. multispina</i> |
| 21b | Abactinal plates small, with fewer than 45 spinules; two rows of intermarginals, extending up to 60 % of R | <i>H. insignis</i> |
| 22a | Abactinal plates round, with 9–35 spinules bearing 3–8+ thorns; abactinal surface with 3 rows of close-set plates, lacking papular areas between, forming distinct lines; adambulacrals with 14–17 spines, 1+ 1–2 + 11–14 in 3 rows | <i>H. lineata</i> |
| 22b | Abactinal plates round on disc, triangular on rays, with 37–60 spinules bearing 3 thorns; adambulacrals with 19–24 spines 1–2+2–3+16–20 in group or 3 rows | <i>H. uluudax</i> |

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